ELECTRONIC INDUSTRIES

A CHILTON PUBLICATION

10th ANNUAL WESTERN ISSUE

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- **Kilomegacycle 'Scopes**

August • 1961

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WASHINGTON News Letter

EXPECT PROMPT ACTION—Prompt action by the National Space Council in developing a government-wide policy on satellite communications is anticipated, ELECTRONIC INDUSTRIES has been advised by a highly placed government source. President Kennedy asked the Space Council to delineate government policy on the nature and diversity of ownership and operation of communications systems in order to bring communications satellites into optimum use at the earliest practicable time. The government authority expressed the view that there is no reason the President's action would delay or affect materially the FCC's current proceedings on space policy.

FCC REORGANIZATION—Senate and House measures to become legislature substitutes for the FCC reorganization plan proposed by President Kennedy and rejected by the House are expected to be enacted into law by Congress before the end of the current Congressional session. Agreement between the two branches of Congress is assured, as both Senate and House measures are nearly identical. FCC Commissioners had sponsored the Senate bill by Senator John Pastore (D., R.I.). The House measure by House Commerce Committee Chairman Harris (D., Ark.) had a provision on the limitation of review of decisions by the Commission made by its delegated panels. This provision has been accepted by Senator Pastore.

FM BAND OVERHAUL—A proposal by the FCC for a complete overhaul of the FM broadcast band looms as the first major spectrum change since the television band was unfrozen in 1952. The projected spectrum change would provide three main types of commercial FM broadcasting stations ranging from local to regional and then to 200-mile protected service areas. Comments have been invited from the engineering officials of FM and other broadcasting services, and from non-broadcast radio fields. They are to be submitted by Sept. 5 with 30 days for added comments. In order to expedite its determination as to such a spectrum change, the FCC adopted this technique and did not include an oral hearing.

SPACE ALLOCATIONS — "Preliminary views" of government frequency experts of allocation of frequency bands for space communications won general commendation from companies and organizations participating in the development of satellite space communications. The views were developed by the Interdepartment Radio Advisory Committee and adopted verbatim by the FCC. Comments of general approval came from the American Telephone & Telegraph Corp., Radio Corp. of America, General Telephone & Electronics Corp., Lockheed Aircraft Corp., and a committee of the National Academy of Sciences. A number of rather minor modifications and revisions were suggested.

COORDINATION OF EFFORTS—Brig. Gen. David Sarnoff, RCA's Chairman of the Board, said in a recent address to the National Press Club that industry should coordinate its knowledge and skills, formulate a definite plan, and concentrate on its objectives, so that the United States can be the first nation to establish and operate a global system of satellite communications. "The much-debated question of satellite ownership is, in my opinion, far less important at this time than the adoption of the right system at the earliest possible moment," General Sarnoff declared. The RCA Chairman was optimistic that satellite communication systems will be a certainty "in this decade."

CERTAIN SPACE FUNDAMENTALS—General Sarnoff emphasized that certain fundamentals regarding the problems involved in satellite communications must be borne in mind. First, he said, being basically distance boosters, satellites will expand, broaden, and speed up the communications services of the day, "as if we picked up a microwave tower from the ground and hung it in the sky." Second, General Sarnoff scoffed at suggestions that a satellite system would make international communications become a $100-billion-a-year business and said that in the seventies, with a satellite system in use, international communications operating revenues may reach the $1 billion mark as contrasted with the present business of about $135 million.

National Press Building *ROLAND C. DAVIES*
Washington 4

INSTITUTE OF THE AEROSPACE SCIENCES (IAS) has received a grant from the National Science Foundation to prepare a comprehensive annual subject index to the world literature of aerospace technology.

USE OF PORTABLE FM RADIOS on U. S. civil aircraft has been prohibited by the Federal Aviation Agency in a Special Civil Air Regulation, SR 446, effective May 25, 1961. The rule was based on results of an investigation of the effect of portable electronic devices operated in aircraft, including radios, dictating machines and recorders. Only radios having oscillators operating within or very near the VHF band used in aircraft—108 to 118 megacycles—affected instruments in the various aircraft on which the tests were made. More detailed tests will be made later in the year.

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ELECTRONIC INDUSTRIES

Vol. 20, No. 8 **August, 1961**

FRONT COVER: To mark this 10th Annual West Coast edition of ELECTRONIC INDUSTRIES, our cover design is a composite of the covers of the nine previous WESCON issues, dating back to August 1952.

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An Evaluation of Kilomegacycle Oscilloscopes page 92

The only effective device for viewing non-recurring events at high frequencies is the traveling-wave oscilloscope.
The newer sampling devices used for frequencies of 1 KMC are compared in display techniques, and evaluated against TW 'scopes.

Solid State Pulse Modulators page 98

By using 4-layer diodes modulators can be made lighter in weight, and smaller in size, while handling higher peak pulse-power. Circuit design is relatively simple, and tough environmental specs can be achieved.

Audio-Visual Learning—It's More Than Hear-Say! page 103

Too often we sweep up new techniques and apply them without proper study. Many firms are now ready to adopt the audio-visual method the same way. Here's the full story on its advantages, disadvantages, and capabilities—by an engineer at the firm where it all started.

Programming for Dielectric Constants page 106

Digital Computers are often misused by improper or duplicated programming. Proper use of the numerous programmed subroutines can eliminate much of this waste. Here's a program for computing dielectric constants and loss tangents.

Rapid Design of Coupled Coaxial Filters page 108

This design technique quickly determines the specification parameters to construct a waveguide filter.

How to Design Low-Noise Amplifiers page 112

Internal noise is always difficult to predict. As usual, two approaches are possible—mathematical and empirical. Using the latter this article shows how an accurate prediction can be made. And the required design data can be obtained by applying tests to the external terminals of the transistor.

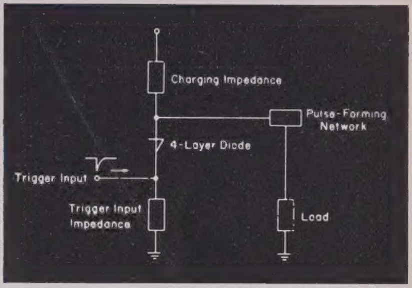
WESCON—The Show and Convention page 120

WESCON provides one of the world's most important technical forums. About 120 authors will cover the latest developments, during forty panel sessions. The themes will include radio astronautics, coherent light generators, and quantum electronics. Over 1200 booths will display the latest hardware achievements, and include sections for production and materials, and publications.

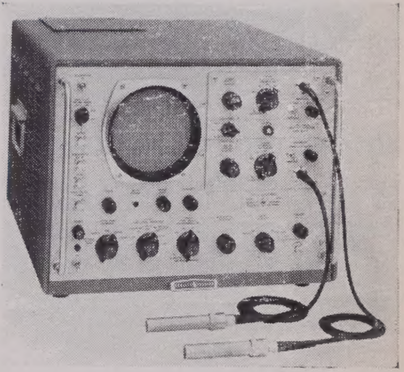
Designing a Frequency Division Multiplexer page 210

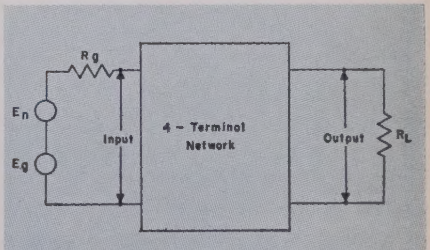
The Air Force, as with all military services, must maintain world wide, high capacity communications links. With a crowded frequency spectrum the answer is multiplexers. Equipment must be compatible with existing facilities and expandable from 12 channels to 600 channels. A system meeting all of these requirements is under development and is described here.

Video-Sonics



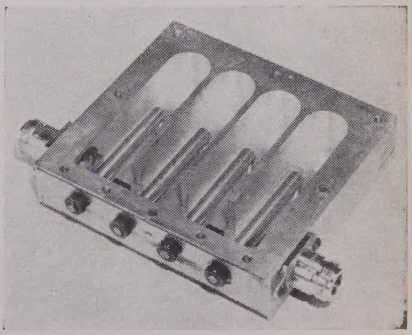
Solid State Pulse Modulators


Kilomegacycle 'Scopes

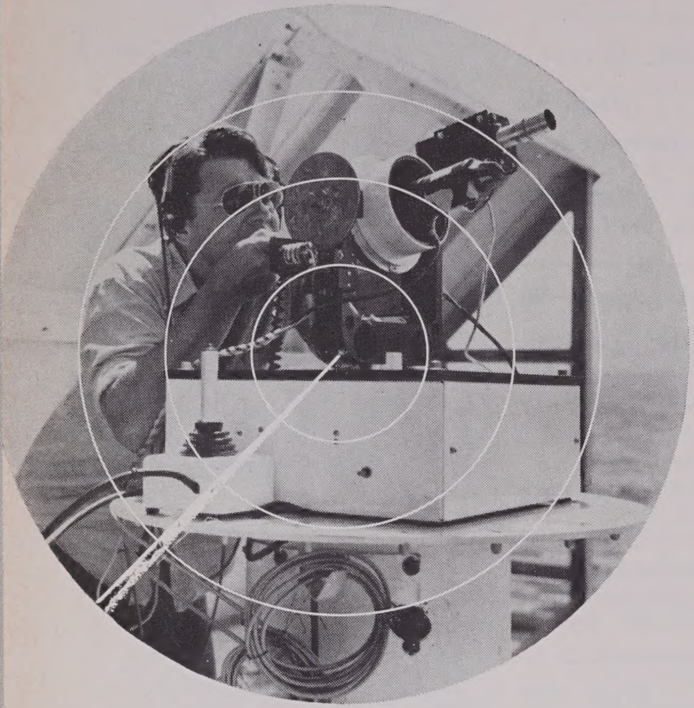


Low-Noise Amplifiers

Co-Axial Filters



RADARSCOPE



AUTOMATED IR TRACKER

Mounted on the missile-tracking ship USAS American Mariner is this automatic infra-red tracker designed and built by the Army Rocket and Guided Missile Agency and modified for shipboard use by Barnes Engineering Co. Instrument is pointed at missiles with a joystick, then automatic tracking signals are produced.

THE ELECTRONIC INDUSTRIES ASSOCIATION "strongly supports" a tax incentive for plant modernization which would provide a flat 10% credit on investment in new plant and equipment.

AN ESTIMATED 76% OF ALL ENGINEERS and scientists employed by the U. S. electronic industry are supported by government funds, according to a survey recently conducted by the Electronic Industries Assoc. with the cooperation of the Dept. of Defense. The remaining 24% are engaged in commercially supported activities. An estimated 155,000 engineers and scientists are performing electronics work in all areas. Eighty-three per cent, or 128,000, are employed by industry; 8% are working for the Federal Government, and 5% are doing research work for universities and non-profit organizations.

BUSINESS MACHINE EXPORTS (including EDP equipment) in the first quarter this year totaled $77,953,943, a 74% increase over the first three months of 1960. Japan was the best single country market, but exports to South America showed the greatest percentage increase—133%. This is one of the areas where U. S. producers have been meeting increasing competition from Europeans.

"IT IS TECHNICALLY FEASIBLE" to move large blocks of electric power, in the order of 10 to 25 billion kw. hours annually, over distances from 400 to 1,000 miles, at extra high voltage, it was reported to the AIEE Summer General Meeting. The study deals with transmission at 460, 575 and 690 kv.

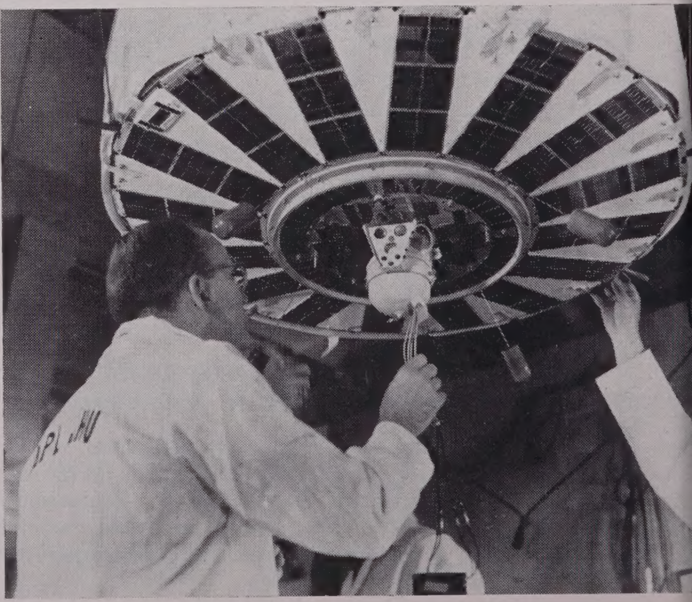
SMALL RADAR UNIT IS AVAILABLE for private planes and boats. Developed by Westinghouse, unit has hand held radar screen with the shape, size, and weight of a telescope. Essential element of the scope is a high-resolution cathode-ray tube 7 in. long.

FIRST PRODUCTION-LINE APPLIANCE to use the principle of thermoelectricity will be a water cooler. Refrigerated directly from electricity, cooler has no moving parts. Electricity passes through two dissimilar metals, developing the required cooling without conventional compressor. Westinghouse developed it.

ELECTRONIC ENGINEERING GRADUATES are receiving nearly 4% higher starting salaries, than in 1960, according to the Electronics Engineering Dept. of Calif. State Polytechnic College. Fifty CSPE graduates accepted offers from industry with an average of 490/mo., with a high of 528/mo. (GS-7), and a low 444/mo. (GS-5). It is important to note that private industries' low of 525/mo., which generally was offered to the lower 25% of the class, is the same as the government's high of 528/mo.

NUCLEAR POWER PLANT

A small SNAP (Systems for Nuclear Auxiliary Power) generator is fastened to the base of the latest Transit satellite before vibration tests at Johns Hopkins' Applied Physics Lab. Built for the AEC by The Martin Co., SNAP is fueled with plutonium-238.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

A FOURTH TV NETWORK supported by the goverment "is urgently needed to solve the programming ills and excesses prevalent in commercial networks and individual stations," says Dr. Allen B. DuMont.

SHIPMENTS OF ELECTRONIC COMPONENTS by U. S. electronic manufacturers in 1960 had an estimated value of $3.4 billion, the Electronics Division, Business & Defense Services Admin., U. S. Dept. of Commerce reports. The level of shipments was more than 10% above that for 1959. Almost 40% of the principal components on which data were collected were for military end-use. Shipments of semiconductor devices reached $542 million in 1960, up 37% from $395 million in 1959.

U. K. EXPORTS OF ELECTRONIC PRODUCTS to the U. S. during the calendar year 1960 totaled $19.6 million—a drop of more than 10% from the record level of nearly $22 million in 1959. Shipments of record playing mechanisms, which formerly accounted for over 50% of the total exports of electronic equipment and parts to the U. S., dropped some 34%—from $12.41 million in 1959 to $8.1 million in 1960. Substantial gains were made in exports of commercial and industrial equipment, and exports of tubes and components increased appreciably.

PRODUCTION PEOPLE ARE LOOKING FOR automated systems which test products on the assembly line, classify the results of these tests, and offer immediate analysis of trends in the manufacturing process. Presented in the basic language of the quality control man, these analyses help keep the process under control. A significant bid for this business is being made by G.E. which last month introduced a line at Quality Information and Test Systems which "will pay for themselves in less than two years." Most of the equipment is in operation at General Electric plants.

COLLEGES AND UNIVERSITIES spent $154 million during 1958 for facilities and other capital items needed for research and development purposes in the natural and social sciences, the National Science Foundation reports. Approximately three-fourths ($112 million) of the total funds expended for R&D facilities came from non-Federal sources —the institutions' own funds, State appropriations, or private endowments.

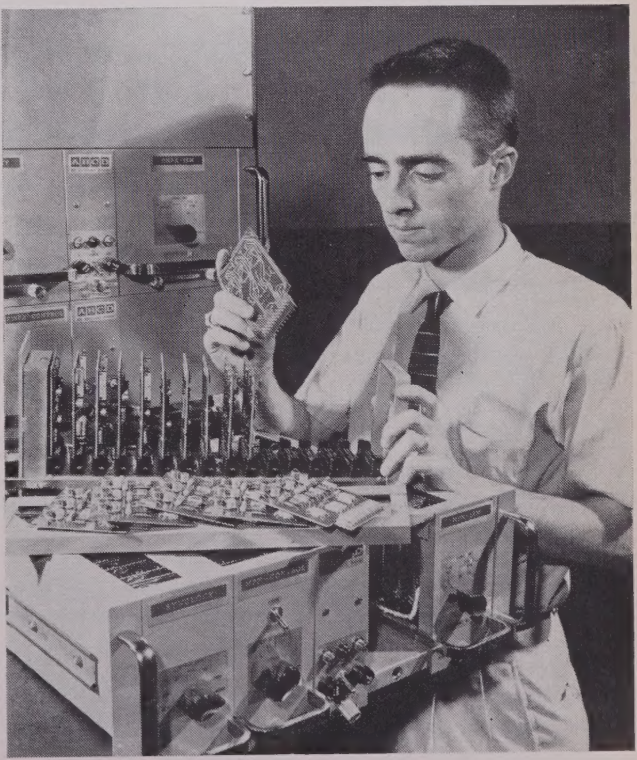
THE FCC MAY REFUSE to license VHF translators to TV broadcast stations who are using the translators to extend their service areas. There has been a growing tendency for TV stations to regard VHF translators as a means of extending service beyond their normal areas, either by operating the translators themselves or being financially interested in a translator licensee of a different name. The FCC believes that unless some restrictions are imposed, VHF translators will become another weapon in the competition between TV licensees rather than an instrument to be utilized by people living in areas receiving little, if any, TV service.

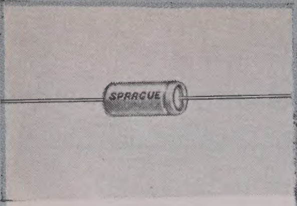
ARMED SERVICES ELECTRO-STANDARDS agency, Ft. Monmouth, is warning manufacturers and suppliers that Armed Services policy does not permit advertising or promotional articles which reference qualification material or contain qualification information. The DOD does not object to advertisements which state that a product "meets," "conforms to," or is "made to" government specifications, provided the words are neither deceptive nor false. But, such a statement does not connote Departmental endorsement, and the determination as to whether the product actually meets a specification is the responsibility of the purchaser.

For More New Developments
See "As We Go To Press"—Page 7

BUILDING BLOCK APPROACH

At ACF Electronics engineer Mike Balderson places a basic module — a plug-in printed circuit card — into equipment that handles high speed transmission of digital data over long distances. System, called "ABCD," for ACF Building Block Communications Devices, adapts teletypewriters, computers and tape machines for simultaneous transmissions of digital information.

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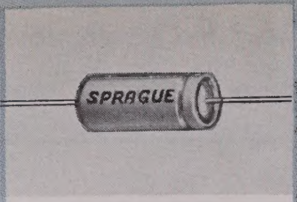
SOLID-ELECTROLYTE TANTALEX® CAPACITORS
Type 150D
Engineering Bulletin 3520D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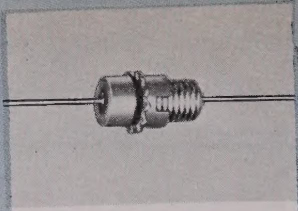
SOLID-ELECTROLYTE TANTALEX® CAPACITORS
Type 151D
Engineering Bulletin 3521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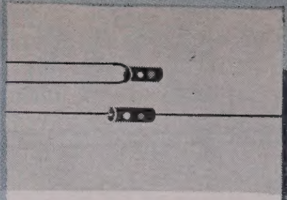
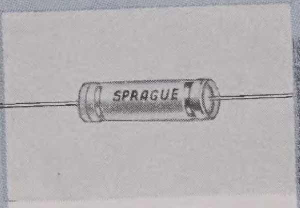
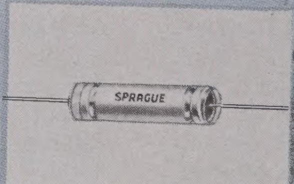
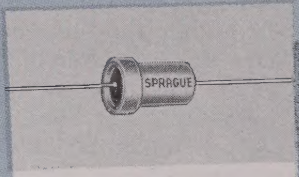
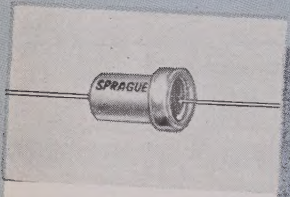
SOLID-ELECTROLYTE TANTALEX® CAPACITORS
Type 180D
Engineering Bulletin 3525

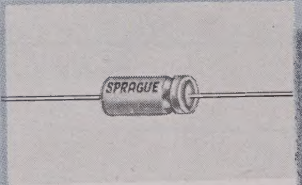

SOLID-ELECTROLYTE TANTALEX® CAPACITORS
for Hearing Aids
Type 160D
Engineering Bulletin 3515A

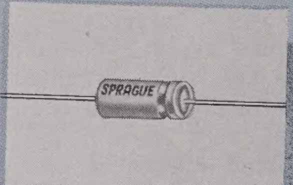

85 C FOIL-TYPE TANTALEX® CAPACITORS
Type 110D, 111D (plain foil)
Type 112D, 113D (etched foil)
Engineering Bulletin 3601A


125 C FOIL-TYPE TANTALEX® CAPACITORS
Type 120D, 121D (plain foil)
Type 122D, 123D (etched foil)
Engineering Bulletin 3602A


'CUP-STYLE'
85 C SINTERED-ANODE TANTALEX® CAPACITORS
Type 131D (industrial)
Type 132D (vibration-proof)
Engineering Bulletin 3710A


'CUP-STYLE'
125 C SINTERED-ANODE TANTALEX® CAPACITORS
Type 133D
Engineering Bulletin 3711


85 C SINTERED-ANODE TANTALEX® CAPACITORS
Type 109D
Engineering Bulletin 3700D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Type 130D
Engineering Bulletin 3701

'MICROFARAD-PACKAGE' TANTAPAK* CAPACITORS
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As We Go To Press . . .

Philco Announces New High Freq. Transistor

Coincident with production of their 25,000,000th transistor Philco last month revealed that a new transistor type is being developed which combines precision-etch and epitaxial deposition techniques. This device — the MLT (Micro Layer Transistor)—is expected to have frequency capability in the 10,000 mc range.

In its present form, the MLT is fabricated by etching emitter and collector pits in N-type germanium to form an extremely thin base-width (on the order of 0.01 mils thick). Epitaxial layers of intrinsic germanium are deposited on opposite sides of a wafer, and P-type electrodes are subsequently plated and micro alloyed in the pits. A P-I-N-I-P structure is thus formed. The combination of extremely thin base with an intrinsic region under the emitter and a P-layer of proper concentration under the collector permits a considerable increase in frequency capability.

Precision-etching may also find application in the new MIA (Metal Interface Amplifier) recently announced by Philco Research. Both the MLT and MIA devices are completely compatible with Philco's FAST Line manufacturing process.

"Doppler VOR" Navigational Aid

A new version of a navigational aid for pilots called a "Doppler VOR" has been commissioned by the Federal Aviation Agency for the first time at Marquette, Mich. Doppler VOR's have been adopted by FAA as a means of providing electronic guidance for air navigation at unfavorable locations. Both standard VOR and Doppler can be received on normal aircraft VOR equipment and the pilot can tune either signal without regard to ground equipment.

VOR's form the basis of the federal airways system by providing a constant and static-free source of bearing or direction to pilots of equipped aircraft. Commissioning of the Doppler VOR at Marquette marks the first time that FAA has installed the new type navigational aid for operational use as part of its federal airways system.

POLARIS CREW TRAINING

Crewmember at right is taking star sight with Type 11 periscope, part of Polaris Submarine navigational training system at U.S.N. Subschool, New London, Conn. "Simulator" was built by Reflectone Electronics, Inc., Stamford, Conn., to duplicate Polaris missions. Two crews will exchange places, one going to sea, the other keeping at top efficiency through use of the simulator.

Super-Power Electron Microscope Installed

A super-power electron microscope has been installed at the University of Pittsburgh. It is the first of its kind in the U. S. and will be used for research in the University's Department of Anatomy, it was announced by Philips Electronic Instruments, Mount Vernon, New York.

The Norelco EM-200 Electron Microscope, provides direct magnification from 300 X to 200,000 X and with photo enlargement beyond 2,000,000 X. Resolving power of the microscope is consistently below 10 Angstroms.

Alignment Group Sensing Platform

An Alignment Group Sensing Platform which will aid in launching Atlas ICBM's on a precise, predetermined course underwent final Air Force acceptance testing recently at a General Mills Electronics Group plant in Minneapolis, Minn.

The Atlas inertial guidance system uses an optical device, known as the Alignment Group Sensing Platform, for missile azimuth alignment. It consists of an azimuth alignment theodolite manufactured by General Mills, and a precision mounting table manufactured by Pratt-Whitney. Arma Div. of American Bosch Arma Corp. is prime contractor for the system.

In use, the theodolite establishes a geographical reference for the missile inertial guidance gyroscopes by precisely measuring angles from fixed bench marks at the launch site. It then monitors twin beams of light reflected from a mirror prism located on the gyroscopically controlled stable platform within the missile. Any deflection of the light beams indicates a change in missile orientation. Orientation of the missile is then corrected and held automatically, even to the moment of launch, by electronic circuitry between the theodolite and stable platform in the Atlas ICBM, thus insuring precise missile control under adverse factors.

More on Page 8

TELEX SYSTEM

Ann Bonar of Western Union Telegraph Co. demonstrates how a subscriber can send messages to any Telex point without manual connections being made. No attendance is required at the destination point. Telex is a "direct - dial" two - way record communication service, providing office-to-office and city-to-city data and message transmission.

Electronic SHORTS

▶ **NASA Marshall Space Flight Center, Huntsville, Ala. is considering the possibility of constructing an off-shore launch facility for heavy space vehicles. The off-shore facility, if it materializes, would be for use in launching Saturn-class space vehicles.**

▶ AEC's radiation tower to be built in the Nevada Desert to study nuclear bomb-burst effects, will use a fast burst reactor being built by United Nuclear Corp., White Plains, N. Y. This pulse-type nuclear reactor is capable of generating 63 billion watts for 38 microseconds. Energy released safely simulates the bomb-burst radiation without an explosion.

▶ **A contract to develop a prototype flow control system for monitoring the water flow in atomic reactors has been awarded to Hydro-Aire Co., Burbank, Calif. by the AEC. The system will be required to monitor the 1,076 different pipes that are used to carry water as a cooling agent in nuclear reaction.**

▶ A worldwide satellite communication system will be operating by 1965-70 according to Henri Busignies, vice president and general technical director of ITT Corp. He disclosed that ITT has already equipped one ground terminal and is planning another.

▶ **National Bureau of Standards has added to its measurement facilities at Boulder, Colo. a system which can break seconds down to parts in millionths and, at the same time, synchronize clocks to its ultra-precise standard. The system has been made possible by the Loran-C (LOng RAnge Navigation) system developed by Sperry Gyroscope Co., Great Neck, N. Y.**

▶ A communications control system, designed for use in NASA's Wallops Island Station alerting program is being installed by Jerrold Electronics Corp., Phila., Pa. The system, when completed, will provide remote control two-way radio communication with air, sea and ground observation points.

▶ **An automatic landing system which electronically guides an aircraft to "touchdown" without the pilot being required to touch pitch and bank controls or to make visual contact with the carrier will be installed aboard ten Navy carriers. Made by Bell Aerosystems Co., Buffalo, N. Y., the system will improve aircraft operations during unfavorable weather conditions.**

▶ A U. S. Navy contract to develop a thermoelectric air conditioner which will be suitable for operational testing aboard a nuclear submarine or a surface ship has been awarded the Carrier Corp., Syracuse, N. Y.

▶ **A sun-powered laser which would permit use of direct sunlight to power a system for communicating with satellites and other space objects is being developed by the American Optical Co., Southbridge, Mass. The laser is expected to be jam-free and capable of transmission over immense distances.**

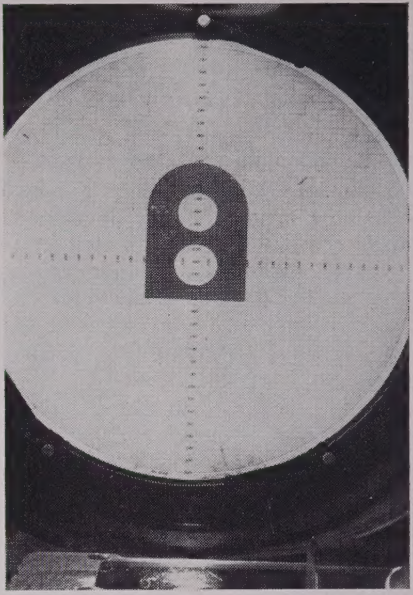
▶ NASA's George C. Marshall Space Flight Center, Huntsville, Ala. has awarded General Electric a contract for the development of a cryogenic accelerometer far more sensitive and accurate than any now in existence. It will have application wherever there is a need for ultra-precise measurement of acceleration or gravity.

▶ **First physical evidence that life forms exist outside our own planet has been reported by a team of scientists from Fordham University and Esso Research and Engineering Co. The discovery was made by analyzing pieces of a 97 year old meteorite using a Type 21-103C mass spectrometer manufactured by Consolidated Electrodynamics Corp., infrared and ultraviolet spectroscopy, and x-ray diffraction technique.**

▶ The Department of Commerce reported that in 1959, the latest year for which figures are available, more than $70 million was spent for research and development in the field of semiconductors. Private industry underwrote over $54 million of this and U. S. Governmental agencies the remainder.

As We Go To Press (cont.)

Memory Cores



Two-hole ferrite core not much larger than a pinhead appears deceptively enlarged on the face of a comparator at IBM, Oswego, N. Y. Cores like this are key components in NASA's Orbiting Astronomical Observatory which will orbit 500 miles above the earth.

"Ding Dong" Tower

Construction will soon begin on a "ding-dong" microwave antenna boresighting tower at the Kearny Mesa engineering facility of Ryan Electronics in San Diego, Calif. The tower is actually a vertical boom with a counterweighted base, mounted on a horizontal axis so that it can be swung through 180° of arc. It will be 30 ft. high. The tower was designed for sampling cross sections of radiation patterns produced by fixed transmitting antennas. A receiver will be mounted on the boom and will be adjustable to its full 30 ft. radius of arc.

Camera Photographs Planets in Daylight

A special Air Force camera has been photographing missiles, satellites and planets in broad daylight. It has captured clear, distortion-free pictures ordinarily obtained only during night hours.

The "Facet-Eye Camera" consists of 19 long-barreled five-in. refracting telescope linked to as many TV-like image-orthicon tubes. The giant camera has been installed at the Air Force Missile Development Center, Holloman Air Force Base, N. M., one of seven maintained by the Air Force Systems Command.

Quick Solutions

to Your Remote Actuation Problems

OAK ROTARY SOLENOIDS—Designing remote automatic positioning devices? Need a rugged, reliable remote actuator for master-slave incremental positioning, for cam lifts, clutches, brakes, or presettable counting devices? Then you should investigate Oak Rotary Solenoids. Despite their small size, they'll meet shock and vibration requirements of MIL-S-4040A. Stepping torque values range from 6.4 to 64 inch-pounds depending upon angular stroke, temperature, duty cycle, and amount of power used. Designed for intermittent DC operation, these custom-built units can be adapted to provide stepping angles of 25°, 35°, 45° and 67.5° in right- or left-hand rotation.

Contact your local Oak sales representative to find out how Oak Rotary Solenoids can help you solve your remote actuation problems. Write for our free descriptive brochure or send a description and sketch of your circuit to our Applications Engineering department.

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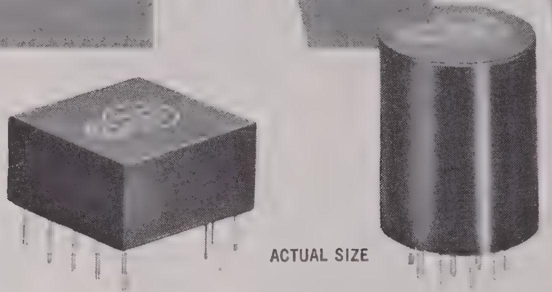

EECO NOR CIRCUITS

FROM LOGIC EQUATION TO SYSTEM PROTOTYPE IN ONE STEP

That's how simple it can be when EECO's new U-Series Digital NOR-Circuit modules are used. Engineering time can be spent designing **systems**, because EECO has taken care of circuit details. The first units of this new family of compatible germanium transistor circuit modules operate over the frequency range of 0 to 25 kcs. These units are designed to meet the requirements of MIL-STD-202B, as modified by temperature specifications of individual units.

PACKAGING

Two packaging styles are available. Both use **all-welded** electrical connections and both are encapsulated. Rectangular units with wire leads (to simplify dip-soldering) are available for installation on circuit cards. Cylindrical units with pins are available for installation in tube-type sockets. This latter package is admirably suited for system breadboarding. System wiring can be accomplished at the sockets; modifications in system design can be performed easily and rapidly. The cylindrical packages measure ⅞″ diameter by 1.0″ seated height. The rectangular packages measure 0.95″ long by 0.95″ wide by 0.5″ seated height.

Write, wire, or phone today for detailed information on the EECO U-Series of NOR units or for information on any of our other families of digital circuit modules.

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Coming Events in the electronic industry

Aug. 1-3: 4th Western Reg. Mtg. American Astronautical Soc., Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 6: Industrial Research Conf., Columbia Univ., Arden House, Harriman, N. Y.

Aug. 14-17: Nat'l. West Coast Mtg. of Soc. of Automotive Engineers; Sheraton Hotel, Portland, Ore.

Aug. 16-18: 2nd Internat'l. Electronic Circuit Packaging Symp.; Univ. of Colorado, Boulder, Colo.

Aug. 19-24: Naval Aviation Mtg., IAS, U. S. Navy; San Diego, Calif.

Aug. 21: 5th Symp. of the Welded Electronic Packaging Assoc.; Lockheed Missiles and Space Div's. Research Facility, Palo Alto, Calif.

Aug. 21-23: Internat'l. Hypersonics Conf., ARS; MIT, Cambridge, Mass.

Aug. 21-24: Photo Conductivity Conf.; Cornell Univ., Ithaca, N. Y.

Aug. 21-25: Internat'l. Conf. on Photonuclear Reactions, NBS, NSF, ONR, AFOSR/Nuclear Physics Div.; Kimball Union Academy, Meriden, N. H.

Aug. 22-25: WESCON (Western Electronic Show & Conv.), WEMA, IRE (L. A. & S. F. sections); Cow Palace, San Francisco, Calif.

Aug. 23-25: Pacific General Mtg., AIEE; Salt Lake City, Utah.

Aug. 23-25: Biennial Gas Dynamics Symp., ARS; Northwestern Univ., Evanston, Ill.

Aug. 27-30: Symp. on The Solar Corona, Sacramento Peak Observatory, Geophysics Research Directorate (AFCRL); Sacramento Peak Observatory, Sunspot, N. Mexico.

Highlights '62

IRE Internat'l. Conv., Mar. 26-29, Coliseum & Waldorf-Astoria Hotel, New York, N. Y.

WESCON, Aug. 21-24, IRE, WEMA; Los Angeles, Calif.

Nat'l. Electronics Conf., Oct. 9-11, IRE, AIEE, EIA, SMPTE; Chicago, Ill.

NEREM (Northeast Res. & Eng. Mtg.) Nov. 13-15, IRE; Boston, Mass.

Aug. 27-30: Eastern Region Mtg., National Assoc. of Electrical Distributors; Saranac Inn, Saranac, N. Y.

Aug. 27-Sept. 1: 6th Internat'l. Conf. of Coordination Chemistry, AFOSR/Chemical Sciences Directorate, AChS (Inorganic Chemistry Sec.); Wayne State Univ., Detroit, Mich.

Aug. 28-31: Summer Mtg., Mathematical Assoc. of America; Oklahoma State Univ., Stillwater, Okla.

Aug. 28-Sept. 1; Internat'l. Heat Transfer Conf., IAS, ASME, AIChE, ARACE, ChIC, EIC, SAE, IME & IChE (British); Univ. of Colorado, Boulder, Colo.

Aug. 28-Sept. 1: Symp. on Chemical Physics of Non-Metallic Crystals, AEC, NSF, Northwestern Univ., AFOSR/Solid-State Sciences Div.; Northwestern Univ., Evanston, Ill.

INTERNATIONAL

Aug. 1-12: Sydney Trade Fair; Sydney, Australia.

Aug. 28-Sept. 1: 5th Internat'l. Conf. on Ionization Phenomena in Gases; Technische Hochschule Karlsruhe, Munich, Germany.

"CALL FOR PAPERS"

7th Annual Internat'l. Conf. on Magnetism and Magnetic Materials, Nov. 13-16, 1961. Westward Ho Hotel, Phoenix, Ariz. Papers to cover basic theoretical and experimental investigations, potential engineering applications, and apparatus and techniques using recent advances in magnetism. **Deadline** for papers: **August 18, 1961.** Forward to: Dr. F. E. Luborsky, General Electric Co., Research Laboratory, P. O. Box 1088, Schenectady, N. Y.

1962 Electronic Components Conf., May 8-10, Washington, D. C. Papers to deal with new developments in components, component processing techniques, component evaluation and component materials. **Deadline** for 500 word summaries (15 copies) is **October 9, 1961.** Forward to: Mr. Henry A. Stone, Chairman, Technical Program Committee, Bell Telephone Labs., Murray Hill, N. J.

1962 Internat'l. Solid-State Circuits Conf., Feb. 14-16, Phila., Pa. Papers to deal with circuit properties, circuit philosophy, and design techniques related to solid-state devices. **Deadline** for 300 to 500 word abstracts is **Nov. 1, 1961.** Forward to: Mr. Richard H. Baker, Room C-237, MIT Lincoln Laboratory, Lexington, Mass.

1962 IRE Internat'l. Conv., Mar. 26-29, 1962, Waldorf Astoria and Coliseum, New York, N. Y. Only original papers not published or presented prior to the 1962 IRE Conv. will be considered. Papers may be on any field associated with or in electronics. **Deadline** for 100 word abstracts (3) and 500 word summary (3): **Oct. 20, 1961.** Forward to: Dr. Donald B. Sinclair, Chairman, 1962 Technical Program Committee, The Institute of Radio Engineers, Inc., 1 E. 79th St., New York 21, N. Y.

13th Annual Fall Conv. & Technical Exhibit of the Audio Engineering Society, Oct. 10-13, 1961, Hotel New Yorker, New York, N. Y. Some of the topics to be covered: Disc Recording, and Reproducing, Loudspeakers and Systems, Artificial Reverberation, Standards of Measurement and performance, Psychoacoustical Engineering and Bioacoustics. **Deadline** for abstracts of papers is **August 15, 1961.** Forward papers to: Hermon H. Scott, Chairman Convention Committee, AES, 111 Powder Mill Rd., Maynard, Mass.

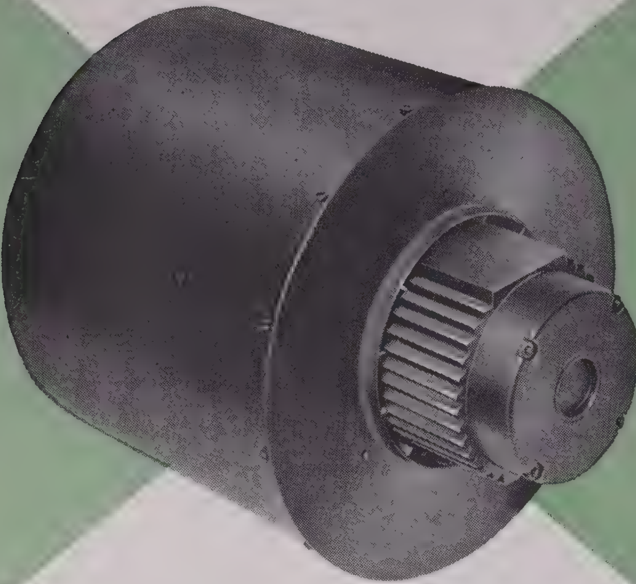
2nd International Congress on Information Processing, Aug. 27-Sept. 1, 1962, Munich, Germany. All aspects of Information Processing and Digital Computers will be covered. **Deadline** for 500-1000 word abstracts is **Sept. 15, 1961.** Forward to: Dr. E. L. Harder, Chairman American Arrangements, Westinghouse Electric Corp., East Pittsburgh, Pa.

12th Nat'l. Conf. of the IRE (PGVC), Nov. 30-Dec. 1, 1961. Papers to deal with vehicular systems, design, techniques, new components, personal signaling, solid state applications and air-ground communications. **Deadline: Sept. 15, 1961,** for 500 word abstracts. Forward to: William J. Weisz, Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

Symp. on Electromagnetic Theory and Antennas, June 25-30, 1962, The Technical Univ. of Denmark, Copenhagen, Denmark. Papers will deal with: Electromagnetic fields in anisotropic media; Diffraction theory; Antenna pattern synthesis; and Quasi-static electromagnetic problems. **Deadline** for 800-1200 word 3 page summary is **December 1, 1961.** Forward to: Technical Program Committee, The Technical Univ. of Denmark, Oster Voldgade 10 G, Copenhagen K, Denmark.

(Continued on page 12)

the pressure's on for '61



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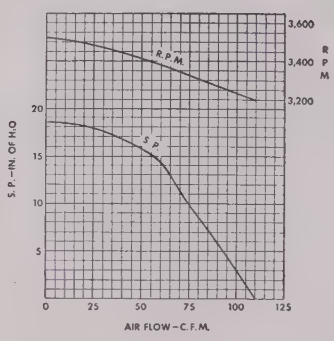
60 cps or 400 cps
1ϕ or 3ϕ
To 440 Volts
10" O.D. by lengths up to 14"
Ambient Range: −55° + 85° C
Commercial or Military



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Coming Events

Continued from Page 11

ENGINEERING EDUCATION

Short courses at leading institutions, of interest to electronic engineers.

Superconductivity

Massachusetts Institute of Technology is holding a Special Summer Program on Superconductivity and its Engineering Applications. The course, scheduled for **August 14-25, 1961,** will give an integrated picture of the physics of superconductivity, the properties of superconductive materials, and their use in computer circuits. No previous knowledge of superconductivity is assumed.

Inquiries and applications should be addressed to: Professor Peter Elias, Head, Dept. of Electrical Engineering, Room 4-202, Massachusetts Institute of Technology, Cambridge 39, Mass.

Precise Measurement

George Washington University's Center for Measurement Science, Washington, D. C., is offering a summer course on the science of precise measurement. Subjects to be covered include "Design of Experiments" and "Time and Frequency Measurements." Date: Aug. 14-25, 1961. Admission limited to persons currently in the field or having a bachelor's degree with working knowledge of algebra and trig.

Space Communications

University of California, Engineering Extension, is offering a short course in "Space Communications," for communication engineers desiring to extend their knowledge of this expanding field. Date: Sept. 5-15, 1961. Inquiries and applications for admission should be addressed to: Dept. K, University of California, Los Angeles 24, Calif.

X-ray

40th Norelco X-ray Analytical School to be held Sept. 11-15, 1961 at the Sir Francis Drake Hotel, San Francisco, Calif. Registration opened, no charge for course, to chemists, metallurgists, physicists, production supervisors, quality control engineers and others interested in X-ray diffraction, diffractometry and spectrography. Contact Philips Electronic Instruments, 750 South Fulton Ave., Mount Vernon, N.Y.

Plant Layout

Univ. of California, Depts. of Engineering and Engineering Extension, is offering a one-week Short Course, **Sept. 17-22, 1961,** in Plant Layout, Material Handling, Warehousing and Shipping. Seminar and workshop for management and supervisory personnel is open to men and firms anywhere in U. S. For program and application write to: Dr. Sam Houston, Dept. K, Univ. Extension, Univ. of Calif., Los Angeles 24, Calif.

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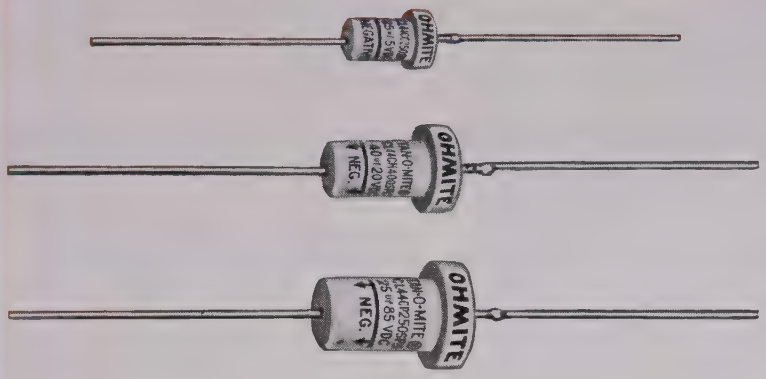
Yes, they are available...from OHMITE



Tan-O-Mite® Series TS Capacitors Meet All Requirements of CHAR. "C" MIL-C-3965B

125°C

TANTALUM SLUG CAPACITORS

Ohmite can supply *all three* sizes of "hat shape" capacitors for use in equipment requiring MIL-C-3965B units. The 29 *basic* stock values as listed at right are the uninsulated type, CL44, with an "S" tolerance of −15 +20%.* They are available also from stock as insulated units, CL45, with plastic sleeves. A "T" tolerance of −15 +50% can be supplied on both types.

Standard tolerance "K," ±10%, is offered on commercial units. Special closer tolerances also furnished.

Ohmite manufactures a big, full line of tantalum slug, foil, and wire capacitors for all pertinent MIL specifications as well as commercial applications. Complete details are covered in Bulletins 148, 152, and 159. *Why not write for a set now?*

*"S" tolerance, as furnished by Ohmite, is closer than the MIL "S" tolerance of −15 +30%.

BASIC STOCK MIL VALUES

Mfd	DC Rated Volts	Case Size	MIL Designation
30	4	T1	CL44CB300SP3
140	4	T2	CL44CB141SP3
330	4	T3	CL44CB331SP3
25	5	T1	CL44CC250SP3
20	7	T1	CL44CD200SP3
100	7	T2	CL44CD101SP3
250	7	T3	CL44CD251SP3
15	10	T1	CL44CE150SP3
70	10	T2	CL44CE700SP3
170	10	T3	CL44CE171SP3
10	17	T1	CL44CG100SP3
8	20	T1	CL44CH080SP3
40	20	T2	CL44CH400SP3
100	20	T3	CL44CH101SP3
5	33	T1	CL44CJ050SP3
25	33	T2	CL44CJ250SP3
60	33	T3	CL44CJ600SP3
4	40	T1	CL44CK040SP3
20	40	T2	CL44CK200SP3
50	40	T3	CL44CK500SP3
3.5	50	T1	CL44CL3R5SP3
15	50	T2	CL44CL150SP3
40	50	T3	CL44CL400SP3
2.5	70	T1	CL44CN2R5SP3
11	70	T2	CL44CN110SP3
30	70	T3	CL44CN300SP3
1.7	85	T1	CL44CP1R7SP3
9	85	T2	CL44CP090SP3
25	85	T3	CL44CP250SP3

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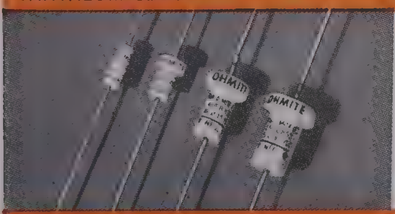
TANTALUM SLUG



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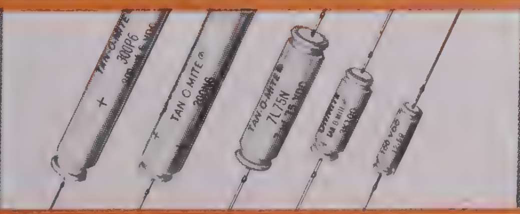

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TEST ELECTROLYTIC CAPACITORS

Safely... Accurately... Simply!

SPECIFICATIONS

Capacitance
Range: 0 to 120,000μF at 120 cps
Accuracy: ±(1% of reading +10μμF)
Sensitivity: ±(0.1% of reading +10μμF)

Dissipation Factor
Range: 0 to 120% at 120 cps
Accuracy: ±(2% of reading +0.1% DF)
Sensitivity: ±(0.2% of reading +0.05% DF)

Maximum Voltage to Unknown
A-C: 0.5v RMS at 120 cps
D-C: 0-600v (with optional power supply)

Null Detection
Built-in Galvanometer to
Indicate Bridge Balance

Power Input
105-125v, 60 cps, 25w

Case
Sturdy Aluminum Cabinet with
Blue Textured Finish, Grey Panel

Dimensions
12" Wide x 12" High x 6" Deep

Note: Five other models, with variations in power inputs and test frequencies, are also available.

■ The Sprague Model 1W1 Capacitance Bridge introduces a new concept in bridge design. Built by capacitor engineers for capacitor users, it incorporates the best features of bridges used for many years in Sprague laboratories and production facilities.

■ Using a line-driven oscillator with but two active elements (diodes), the bridge has a transistorized detector whose sensitivity increases as the balance point is approached. It has provision for 2-terminal, 3-terminal, and 4-terminal measurements, which are essential for accurate measurement of capacitors with low, medium, and high capacitance values, respectively.

■ The Model 1W1 Capacitance Bridge will not cause degradation or failure in capacitors during test, as is the case in many conventional bridges and test circuits. The 120 cycle a-c voltage, applied to capacitors under test from a built-in source, never exceeds 0.5 volt! It is usually unnecessary to apply d-c polarizing voltage to electrolytic capacitors because of this safe, low voltage.

For complete technical data on this precision instrument, write for Engineering Bulletin 90,010 to Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

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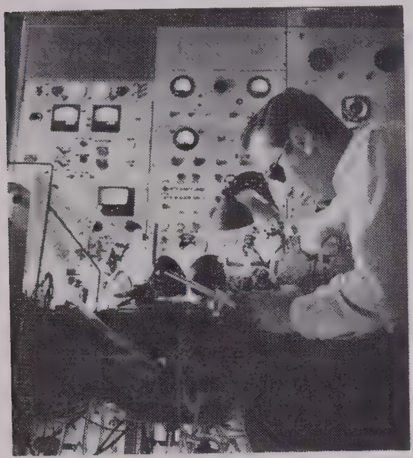
As We Go To Press . . .

Microelectronics Dept. Established At Philco

The Lansdale Division of Philco has formed a new Microelectronics Department to develop, manufacture and market highly miniaturized semiconductor circuits.

William F. Long, former manager of marketing research for the Lansdale Division, will head the new department.

The MECA (Multi-Element Component Arrays) circuits will range from individual components which are assembled in one miniature package to form an electronic circuit, to those which are electrically or chemically deposited on a base, thereby forming integrated circuits, to those which are molecularly "built-in."



At Philco's Semiconductor Div. scientist explores methods of treating semiconductor wafer

Philco presently has microminiature component arrays of two to eight diodes and transistor-diode logic circuits in production stages. Miniature thin-film and solid-state flip-flop circuits are under development.

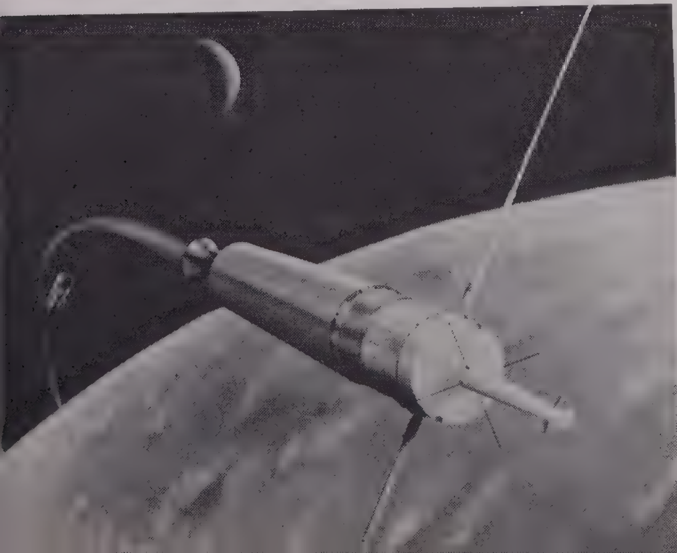
Flight Simulator Delivered to Navy

Full-range performance helicopter trainer has been delivered to th Navy by Melpar, Inc., of Falls Church, Va. Known as the HSS-2 Helicopter Simulator, the land-borne training device incorporates training in all phases of operations which will be encountered by the Sikorsky HSS-2 hunter-killer helicopter.

The trainer simulates the behavior of a total of 20 of the helicopter's systems, including oil and fuel, hydraulic, blade-folding, landing gear and armament. It also duplicates temperature and atmospheric variations, wind-force, ambient light and cloud effects, lightning flashes, rough air, and engine and rotor icing. Even the varying sounds of flight, control-stick pressures and helicopter vibrations have been faithfully duplicated.

Savings Indicated for Radio Production

A "pea-sized" 455 kc i-f filter (2 models: one for transistors; one for tubes) was unveiled at a recent press conference by U. S. Sonics Corp. of Cambridge, Mass. It offers a power loss of 1 db at rated freq. 455 ±1 kc. Being permanently tuned, this ceramic filter can be placed anywhere on a radio chassis, without regard to access for tuning. Company officials believe space savings will result in smaller case size, and time savings will result from automated placing and soldering of these axial lead, zirconate devices. These savings will allow more advantageous pricing of sets.



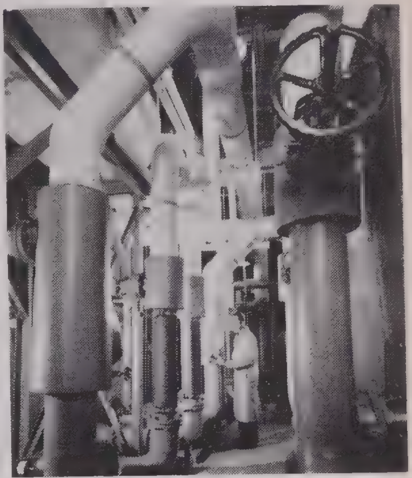
ARGO ROCKET

Artist's rendering of Argo D-4 rocket recently launched in probe of electron density of the upper atmosphere. Data received from equipment in the nose cone was enough for NASA scientists to authorize Airborne Instruments Laboratory of Deer Park, L. I., N. Y., to design and fabricate the payload for the S-48 (Topside Sounder satellite which will be orbited in 1962.

New Plant Stresses Transistor Reliability

A new semiconductor plant designed to produce transistors so nearly perfect that they will be guaranteed with ten times the assurance of similar presently-available devices has been built by the Raytheon Co. at Lewiston, Me. Maine Governor, John Reed said the new plant is the largest industrial structure built in the state in the last half century.

Called the "home of guaranteed transistors" by Raytheon President R. E. Krafve, it was built to accommodate the new Lambda system, the government's highest criteria of quality and reliability measurement. Key to these higher reliability levels is a 6,400 sq. ft. service area. Among other things the service area demineralizes water to a level 350% purer than drinking water, so pure that it has no taste and will hardly conduct electricity.



This 6,400 square foot service area at Raytheon's new Lewiston, Me. plant supplies all the utilities required for modern semiconductor production.

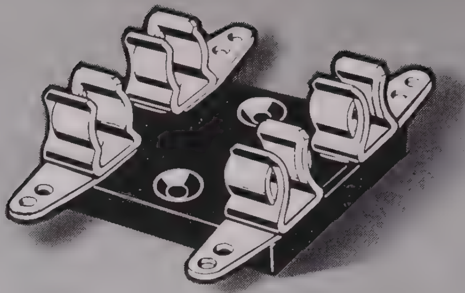
Wanted . . . Technical Papers

The 1962 Electronic Components Conference, sponsored by the AIEE, EIA, and IRE, with ASQC and SNT participating, is soliciting papers on the subject of electronic components and materials. A 500 word summary should be sent to:

Henry A. Stone, Chairman
Technical Program Committee
Bell Telephone Laboratories
Murray Hill, N. J.

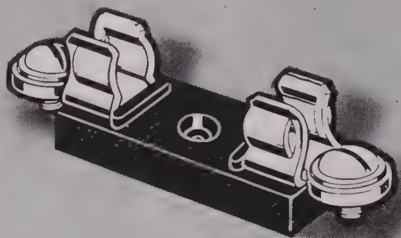
The deadline for the summaries is October 9, 1961.

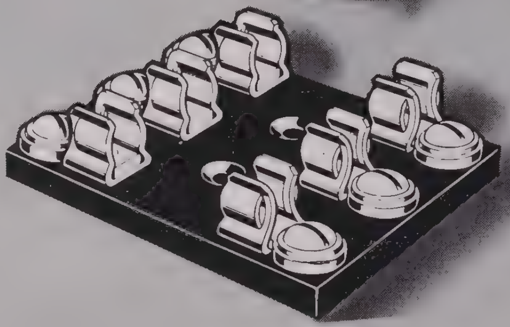
The conference will be held at Marriott Twin Bridges Motor Hotel,, Washington 1, D. C., on May 8, 9 and 10, 1962.



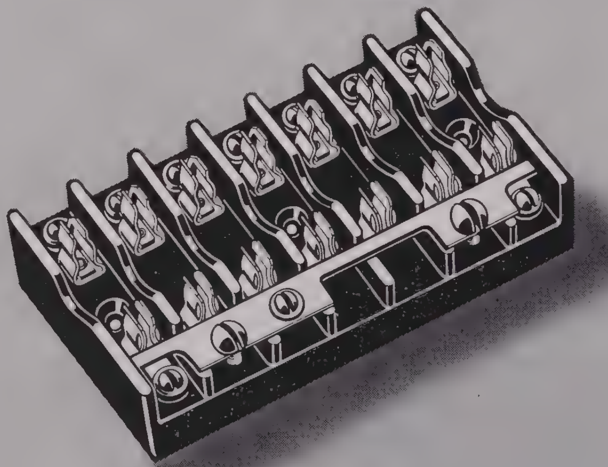
BLOCKS

for BUSS
and
FUSETRON
FUSES

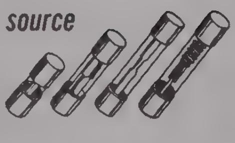




All types available for every application



BUSS and FUSETRON FUSES: One source for all your fuse needs.



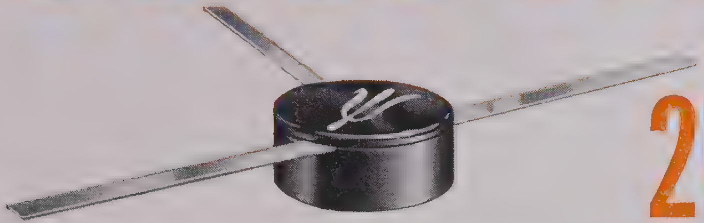
Get full data for your files, write for BUSS bulletin, Form SFB—it gives a comprehensive picture of the complete line of fuses and fuse mountings of unquestioned high quality.

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.,* **UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.**

new!

PSI TRANSISTOR

TO-51 PACKAGE



2N958 • 2N959

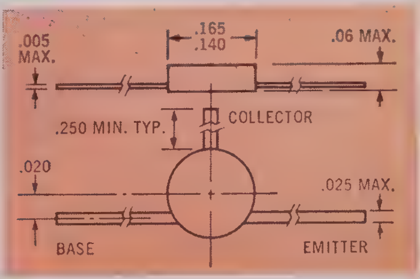
HIGH PERFORMANCE COMPUTER LOGIC SWITCHES

$T_S < 25$ ns • V_{CE} (sat) $< .2V$ • 250mW Dissipation @ 25°C

SPECIFICATIONS

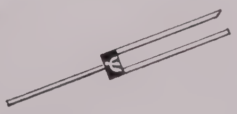
			Min.	Max.
V_{CBO}	25 volts	I_{CBO} @ V_{CB}		0.5μA
V_{CER} (R=10 ohms)	20 volts	h_{FE} V_{CE}=1V (2N958)	20	60
V_{CEO}	15 volts	h_{FE} I_C=10mA (2N959)	40	120
V_{EBO}	5 volts	V_{BE}(sat) I_C=10mA, I_B=1mA	0.75V	0.85V
Power Dissipation @ 25°C	.250 watts	V_{CE}(sat) I_C=10mA, I_B=1mA		0.20V
		h_{fe} V_{CE}=10V, I_C=10mA, f=100 mc		2.0
		C_{ob} V_{CB}=5V		7.0 pf
		T_S I_C=10mA, I_{B1}=I_{B2}=10mA, R_L=1000 ohms		25 ns

DIMENSIONS



THE THREE STANDARD MICRO PACKAGES NOW AVAILABLE FROM PSI

NEW TO-51 PACKAGE for standardization in "swiss cheese" and other advanced methods of component assembly.



PSI MICRO PACKAGE ideally suited for "cordwood" approach to microminiaturization.

PSI PICO PACKAGE this unit offers the ultimate for microminiaturized component assembly.

All illustrations shown in actual size.

There's a PSI Micro-Transistor for every design requirement and every assembly technique. If you're planning a new and original computer design let us hear from you. Just call Bill Eckess, OSborne 9-2281, TWX: HAW CAL 4270 or write PSI Micro-Electronics Division.

Ask for your copy of the new up-to-the-minute "Micro-Electronics Catalog" and "PSI Micro-Diode Reliability Report"

Available at PSI Distributors coast-to-coast

PSI

Pacific Semiconductors, Inc.

TRW A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.
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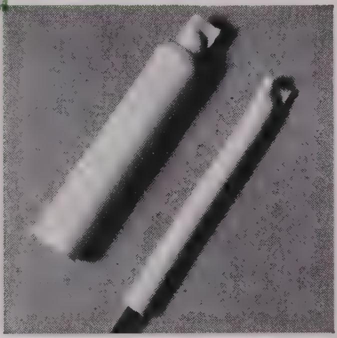
in wire capping



NEW *heat-shrinkable....*

THERMOFIT CAPS

RAYCLAD TUBES
INCORPORATED

A SUBSIDIARY OF
RAYCHEM
CORPORATION

THERMOFIT CAPS are short, irradiated polyolefin sleeves, sealed on one end, which shrink to less than one-half of their original diameter upon the brief application of heat. Upon shrinking, they produce a tough, moisture-tight end-seal with outstanding insulation properties for the most difficult environments.

THERMOFIT CAPS reduce required space to a minimum; conform to variable contours; provide quick and uniform application; are available in standard color-coded sizes; and are low in price.

OAKSIDE AT NORTHSIDE • REDWOOD CITY • CALIFORNIA

News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

ALLIED CHEMICAL CORP., GENERAL CHEMICAL DIV., has announced plans to acquire a plant site near Pottsville, Pa., for its first commercial plant to produce plastic films.

UNITED ELECTRONICS CO., sub. LING-TEMCO ELECTRONICS, INC., Newark, N. J., has been awarded a $25,857 contract for electron tubes by the Dayton Air Force Depot.

SCINTILLA DIV., THE BENDIX CORP., Sidney, N. Y., has received contracts totaling $900,000 for the manufacture of umbilical-type electrical connectors to be used in the launching-tube system of Polaris submarines.

GULTON INDUSTRIES, INC., Metuchen, N. J., has acquired West Instrument Corp., Chicago, Ill., in a transaction valued over $2,800,000.

SUPERIOR TUBE CO., Norristown, Pa., announces plans to enlarge its main plant at Collegeville, Pa., at a cost of about $500,000. The construction will add about 50,000 sq. ft. to the present floor space; 15,000 sq. ft. will be given over to Superior's Nuclear Productions Div.

POLARAD ELECTRONICS CORP., Long Island City, N. Y., has been awarded a contract totaling $164,700 by the U. S. Army Signal Supply Agency, Phila., Pa. The contract calls for 90 AN/UPM-58 spectrum analyzers.

ATLANTIC RESEARCH CORP., Alexandria, Va., has been awarded a contract for $346,000 by the Air Force Flight Test Center, Edwards Air Force Base, Calif., as part of a program to develop a new family of solid propellants.

The Board of Directors of **THE LIONEL CORP.**, and Hathaway Instruments, Inc., have approved Lionel's acquisition of Hathaway on the basis of a one-for-one exchange of Lionel stock for approximately one million shares of Hathaway now outstanding. Lionel will be the surviving corporation.

SPECIALTY ELECTRONICS DEVELOPMENT CORP., Syosset, N. Y., has received contracts for special electrical connectors totaling $1,070,000 from the U. S. Army Signal Corp.

RADIATION, INC., Melbourne, Fla., is developing advanced microwave satellite transmitters and special receivers for wide-band radio transmission under a $379,000 contract awarded by Cornell Aeronautical Laboratory.

GENERAL TELEPHONE & ELECTRONICS CORP., Waltham, Mass., has received a multi-million dollar award for the development of an advanced radar design for possible use in the U. S. Army's Nike-Zeus anti-missile missile system.

MICROWAVE ASSOCIATES, INC., Burlington, Mass., has received contracts from: Avco Corp., Electronics & Ordnance Div.; U. S. Air Force, Aeronautical Systems Div.; and the Dayton Air Force Depot. Totalling $700,000 they are for new microwave ferrite switching devices, solid-state microwave devices and microwave semiconductor diodes.

GENERAL ELECTRIC CO., HEAVY MILITARY ELECTRONICS DEPT., Syracuse, N. Y., has received a $5,301,957 contract advanced high power, search radars for air defense awarded by the USAF Air Logistics Command's Rome Air Materiel Area. The AN/FPS-7 will be used in the SAGE Continental Air Defense System.

FAIRCHILD CAMERA AND INSTRUMENT CORP., Syosset, L. I., N. Y., has acquired the assets of Curtis Laboratories, Inc., and Circle Weld Mfg. Corp., both of Los Angeles, Calif. Curtis Laboratories has been made a dept. of Fairchild's Defense Products Div. and Circle Weld is now a dept. of Fairchild's Special Products Div.

EMERSON & CUMING, INC., Canton, Mass., announces the establishment of a new plant to serve the West Coast. This facility is located at 604 W. 182nd St., Gardena, Calif. The Gardena facility will supply a full line of Emerson & Cuming resin products.

ELECTRONIC MECHANICS, INC., Clifton, N. J., has completed the world's largest facility for the production of man-made mica. The new facility in Clifton, N. J., will have a production capacity of 500 tons annually. Production plans call for large books of 6-inch mica crystals.

MIDWEST

THE VICTOREEN INSTRUMENT CO., Cleveland, Ohio, has received contracts totalling over $3,209,000 for federal civil defense radiological survey meters from the General Services Administration.

THE BENDIX CORP., SYSTEMS DIV., Ann Arbor, Mich., has received a contract for $1,790,000 for the design, development and fabrication of airborne down-range missile measuring equipment.

INDIANA GENERAL CORP., Valparaiso, Ind., announces the acquisition of EICOR Div., Scranton Corp. Sale price was $450,000. Indiana General has also purchased B.M.S. Carbide Specialties Co., Boonton, N. J., for an undisclosed amount of cash.

UNIVAC DIV. OF SPERRY RAND CORP., St. Paul, Minn., has been awarded a contract for $1,046,000 by the Navy Bureau of Ships for the production of peripheral equipment for the Naval Tactical Data System. Univac, St. Paul, also received three additional contracts totalling $1,161,390 for the production of computers and related equipment for the system.

The Board of Directors of **MELPAR, INC.**, sub. Westinghouse Air Brake Co., Falls Church, Va., has approved a plan for acquiring Television Associates, Inc., and its wholly owned subsidiary, Television Associates of Indiana, Inc., both of Michigan City, Ind.

INSTRUMENT DIV., THE HICKOK ELECTRICAL INSTRUMENT CO., has been awarded contracts totalling $725,000 by the Federal Aviation Agency, Navy Bureau of Ships and the Army Air Force. Contracts are for Convertible Wide Band O-scopes and Plug-in Preamps.

CLEVITE CORP., Cleveland, Ohio, has signed an agreement to license rights under its patents in lead zirconate-lead titanate piezoelectric elements with Frenchtown Porcelain Co., Div. of General Battery & Ceramic Corp., Frenchtown, N. J.

WEST

THE GARRETT CORP., AiRESEARCH MFG. DIV., Phoenix, Ariz., has been awarded contracts totalling over $1.3 million for engine starters for the Air Force Hound Dog missile.

HEWLETT-PACKARD CO., Palo Alto., Calif., announced that it will build a new plant in Loveland, Colo., providing over 400,000 sq. ft. of engineering and manufacturing space. The first unit costing approximately $1.5 million will be completed in early 1962.

AMPEX CORP., Redwood City, Calif., has been awarded a $1,436,769 Navy Bureau of Ships contract for the production of 314 two-channel, three-speed magnetic tape recorder/reproducers. The AN/UNQ-7B is designed for surface and undersea craft.

UNITED TECHNOLOGY CORP., Sunnyvale, Calif., has received two research contracts totalling $230,000. One, from Edwards Air Force Base, is for R&D of solid propellant; the other, from ONR, is for research work in the thermochemistry of the high energy fluorine bond.

POWERTRON ULTRASONICS CORP., Garden City, N. Y., announces the opening of its West Coast subsidiary, Powertron Pacific Corp., located at 3277 Wilshire Blvd., Los Angeles, Calif.

SYNTHANE CORP., Oaks, Pa., has opened a new West Coast subsidiary, Synthane-Pacific which is located at 518 W. Garfield Ave., Glendale, Calif.

SPASORS, INC., San Diego, Calif., Avionic development and manufacturing firm, has been acquired by Silicon Transistor Corp., New York, N. Y.

LOCKHEED AIRCRAFT CO., CALIFORNIA DIV., has awarded a contract in excess of $750,000 to Huyck Systems Co., Huntington, L. I., N. Y. The contract calls for design and manufacture of a Doppler/Air Mass Navigational Computer for use in Lockheed's ASW aircraft, the P3V-1.

HOFFMAN ELECTRONICS CORP., INSTRUMENT DIV., has received a contract totalling $60,300 from the Bureau of Naval Weapons for R&D on a miniature low-cost, displacement gyroscope.

TECHNICAL SYSTEMS INC., Culver City, Calif., has purchased all assets of Mason Mold Corp., Covina, Calif.

GENERAL DYNAMICS/ASTRONAUTICS, San Diego, Calif., has received a $2,500,000 contract to build three Atlas missile procedure trainers for the USAF. The equipment will be used to teach launch procedures to crews at the 576th Strategic Missile Squadron, Vandenberg Air Force Base, Calif.

TEXAS INSTRUMENTS INCORPORATED has been awarded an Air Force contract of $268,000 to design and develop an unattended marine seismic monitoring system. The award is part of the seismological research and development program being carried out under project VELA UNIFORM.

MOTOROLA INC., MILITARY ELECTRONICS DIV., Scottsdale, Ariz., has received a $350,000 contract to develop and produce high power C-band pulse transponders for the Air Force Missile Test Center at Patrick AF Base, Fla.

PHILCO EPITAXIAL SILICON MESA

FIRST TO COMBINE

120 V (BV_{CBO})

0.5 V(*SAT*)

150 mc. f_T

2N2087 NPN
CORE DRIVER
LINE DRIVER

TO-5

ABSOLUTE MAXIMUM RATINGS

Storage Temperature ....−65 to +300°C.
BV_{CER} (R≦10Ω) ....80 volts
BV_{CBO} ....120 volts
BV_{EBO} ....5 volts
Collector Current I_C ....500 ma
Total Device Dissipation (case 25°C.)....2 watts
Total Device Dissipation (case 100°C.)...1 watt
Total Device Dissipation (free air 25°C.).0.6 watt

ELECTRICAL CHARACTERISTICS (@ 25°C.)

Characteristics	Conditions	Min.	Max.	
h_{FE}	V_{CE} = 1V. I_C = 150 ma.	40	120	
V_{BE}	I_C = 150 ma. I_B = 15 ma.		1.2	volts
V_{CE}(SAT)	I_C = 150 ma. I_B = 15 ma.		0.5	volts
f_T	I_C = 50 ma. V_{CE} = 10V.	150		mc
C_{ob}	V_{CB} = 10V. I_E = 0 ma.		12	pf
I_{CBO}	V_C = 60V. T = 25°C.		2	μa
I_{CBO}	V_C = 60V. T = 150°C.		200	μa
BV_{CER}	R ≦ 10Ω I_C = 20 ma. pulsed	80		volts
t_r			85	nsec
t_s			100	nsec
t_f			55	nsec

You would expect Philco, as inventor of industry's most capable germanium logic transistor—the MADT, to design Silicon memory components with extra capability, too. And Philco has done it. The 2N2087, forerunner of a broad line of Philco epitaxial silicon mesa transistors, offers an incomparable combination of parameters that may well be the special design solution you require: maximum BV_{CBO} of 120 V., minimum h_{FE} of 40 at $1V_{CE}$, maximum V_{CE} (SAT) of 0.5 V., minimum f_T of 150 mc., maximum C_{ob} of 12 pf., and maximum t_s of 100 nanoseconds.

The new Philco 2N2087 epitaxial silicon mesa delivers optimum drive for computer memory planes, serves as a medium power switch in airborne controls systems, and is ideally suited to a wide variety of other applications such as small power supplies, servo amplifiers, and automation controls. For complete information, write Dept. EI861.

Immediately available in quantities 1-999 from your Philco Industrial Semiconductor Distributor.

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LANSDALE DIVISION, LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER ®

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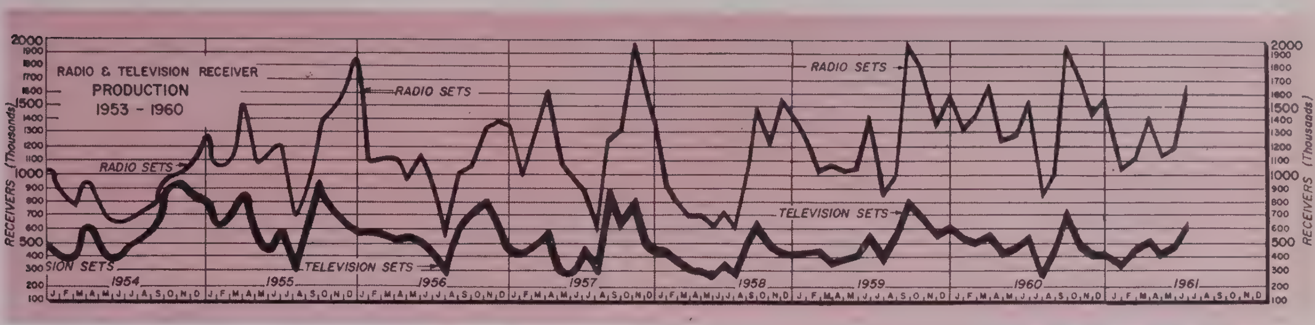
Facts and Figures Round-Up
August 1961

ELECTRONIC INDUSTRIES TOTALS



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in June, 1961.

Amplifiers	454,050
Antennas	1,488,759
Batteries	1,645,419
Beacons	37,950
Cable	672,079
Cable, coaxial	230,411
Cable, telephone	2,620,708
Call sign cipher device	781,333
Capacitor	47,667
Chamber cable terminal	40,380
Coder/Decoder	3,893,237
Communication equipment	630,015
Computers	362,024
Connectors	290,991
Controls	83,971
Coordinate data set	159,262
Correlators, video	143,677
Coupling units	229,268
Crystal unit	26,000
Data converters	92,292
Demodulator	115,402
Dummy load	49,618
Duplexer tee assemblies	42,004
Echo sounder	36,452
Electronic ovens, microwave	37,156
Facsimile set	53,369
Filters	61,331
Frequency synthesizer	63,091
Gyro assys	402,003
Headsets	30,220
Indicators	370,092
Intercommunication equipment	607,789
Magnetic tape	311,141
Meters	859,605
Microphones	300,915
Mode selectors	245,022
Motors	41,707
Oscillograph	25,627
Oscilloscope	2,655,086
Page printer sets	1,201,128
Power monitor	44,530
Power supplies	47,800
Radar	3,359,947
Radiacmeter	246,216
Radio direction finder	1,655,028
Radio set	3,886,347
Radiosonde sets	419,577
Radome	192,261
Receivers	181,000
Recorder	286,534
Recorder/Reproducer	203,959
Relays	93,755
Relay armature	70,720
Resistors	462,996
Semiconductors	205,504
Servos	176,805
Signal generators	407,707
Spectrometer, mass	39,870
Standards	229,952
Switch	263,737
Switchboards	1,843,421
Systems	1,793,237
Telemetry equipment	370,885
Teletypewriters	874,580
Terminals	76,484
Test equipment	977,986
Test sets	779,305
Thermocouple	32,520
Timer	94,500
Towers	379,242
Transceivers	61,680
Transducers	25,708
Transformers	34,090
Transmitters	192,791
Transponders	2,118,598
Tubes, electron	4,949,805
Tubes, Klystron	1,295,300
Tubes, Magnetron	26,160
Tuning forks	36,358
TV equipment	299,673
Vibrator	56,489
X-Ray equipment	140,768

PHONOGRAPH SALES

	Factory Sales		Retail Sales	
	Monaural	Stereo	Monaural	Stereo
May	53,887	142,450	62,328	194,891
April	53,074	152,974	56,312	182,773
March	62,396	227,469	64,138	237,537
February	50,710	204,638	61,646	225,722
January	80,366	211,383	105,753	271,124
Year-to-date '61	300,433	938,914	350,177	1,112,047
Year-to-date '60	342,068	1,197,103	396,362	1,258,417

INDICATED FM RECEIVER SALES

Year	FM & FM-AM Receivers	FM Tuners	TV Sets with FM Radio	Total
1956	217,000	not available	not available	217,000
1957	183,300	not available	not available	183,300
1958	303,800	not available	not available	303,800
1959	540,500	606,902	not available	1,147,402
1960	904,800	613,373	126,990	1,645,163

Note: Figures for 1956 and 1957 for FM & FM-AM receivers are not strictly comparable with succeeding years.

Although these figures are actually factory sales they provide a good indication of FM receiver sales to consumers.

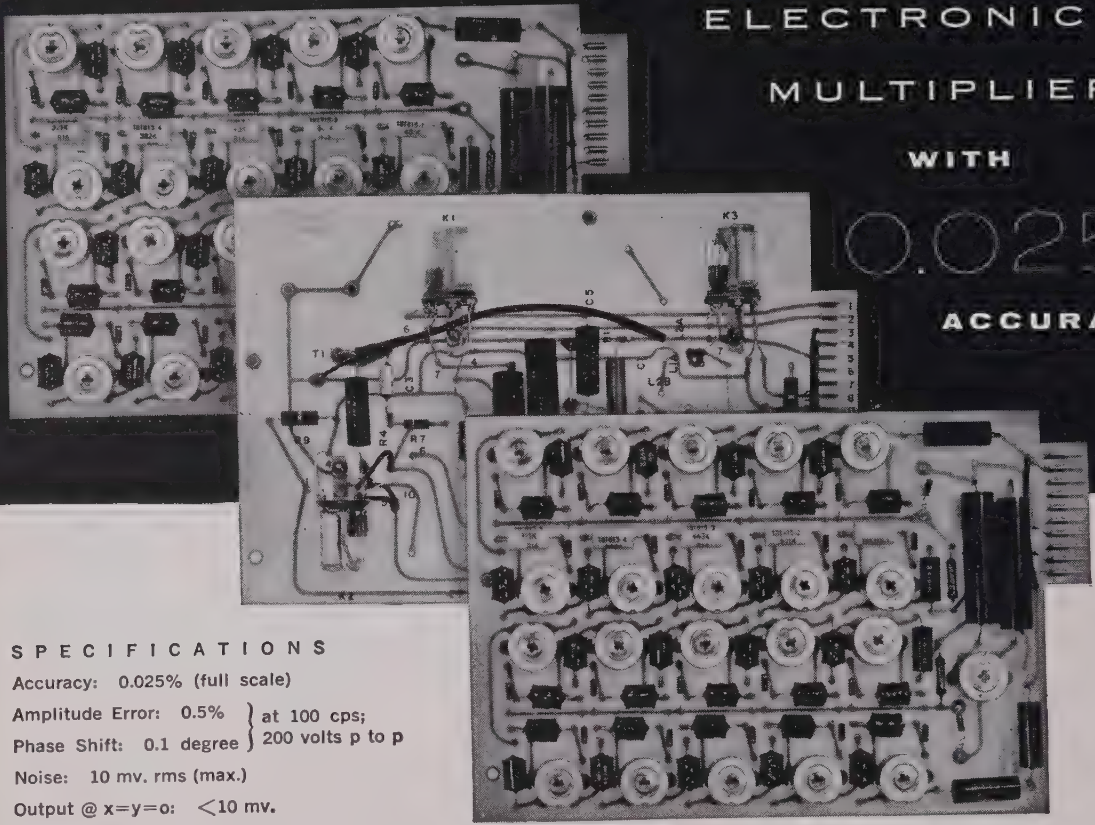
TWELVE-MONTH TREND IN FACTORY SALES OF FM RECEIVERS

1960	FM Radios & Phono Combinations	TV Sets with FM Radio	Total
March	132,936	4,108	137,044
April	77,729	7,844	85,573
May	72,634	8,022	80,656
June	133,104	6,988	140,092
July	77,934	5,124	83,058
August	111,871	9,774	121,645
September	218,617	21,119	239,736
October	177,630	17,943	195,573
November	175,758	14,157	189,915
December	132,565	17,813	150,378
1961			
January	99,602	5,092	104,694
February	107,474	10,549	118,023
Total	1,517,854	128,533	1,646,387

Source: E.I.A.

from the acknowledged leader in analog computer design

REAC® SOLID STATE ELECTRONIC MULTIPLIERS WITH 0.025% ACCURACY



SPECIFICATIONS

Accuracy: 0.025% (full scale)
Amplitude Error: 0.5% } at 100 cps; 200 volts p to p
Phase Shift: 0.1 degree } at 100 cps; 200 volts p to p
Noise: 10 mv. rms (max.)
Output @ x=y=o: <10 mv.

MULTIPLIER CONSOLES

Compatible with all analog computing equipment.

1. Eight Independent Products.
2. Expandable to 16 Products with adapter kit.
3. Adequate power for expansion to 16 products.
4. Operational Amplifier for each product.
5. Amplifier Balance Meter.
6. Standard Rack Mounting.

WITH THESE OUTSTANDING FEATURES:

- FOUR QUADRANT MULTIPLIER
- EXTREME DYNAMIC RANGE
- TEMPERATURE COMPENSATED
- FACTORY CALIBRATED, NO FIELD ADJUSTMENTS
- SILICON JUNCTION DIODE SHAPING NETWORKS
- PRINTED CIRCUIT PLUG-IN CARDS

For complete specifications, write for data file 308.

Qualified engineers seeking rewarding opportunities in these advanced fields are invited to get in touch with us.

Reeves

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IRV61R

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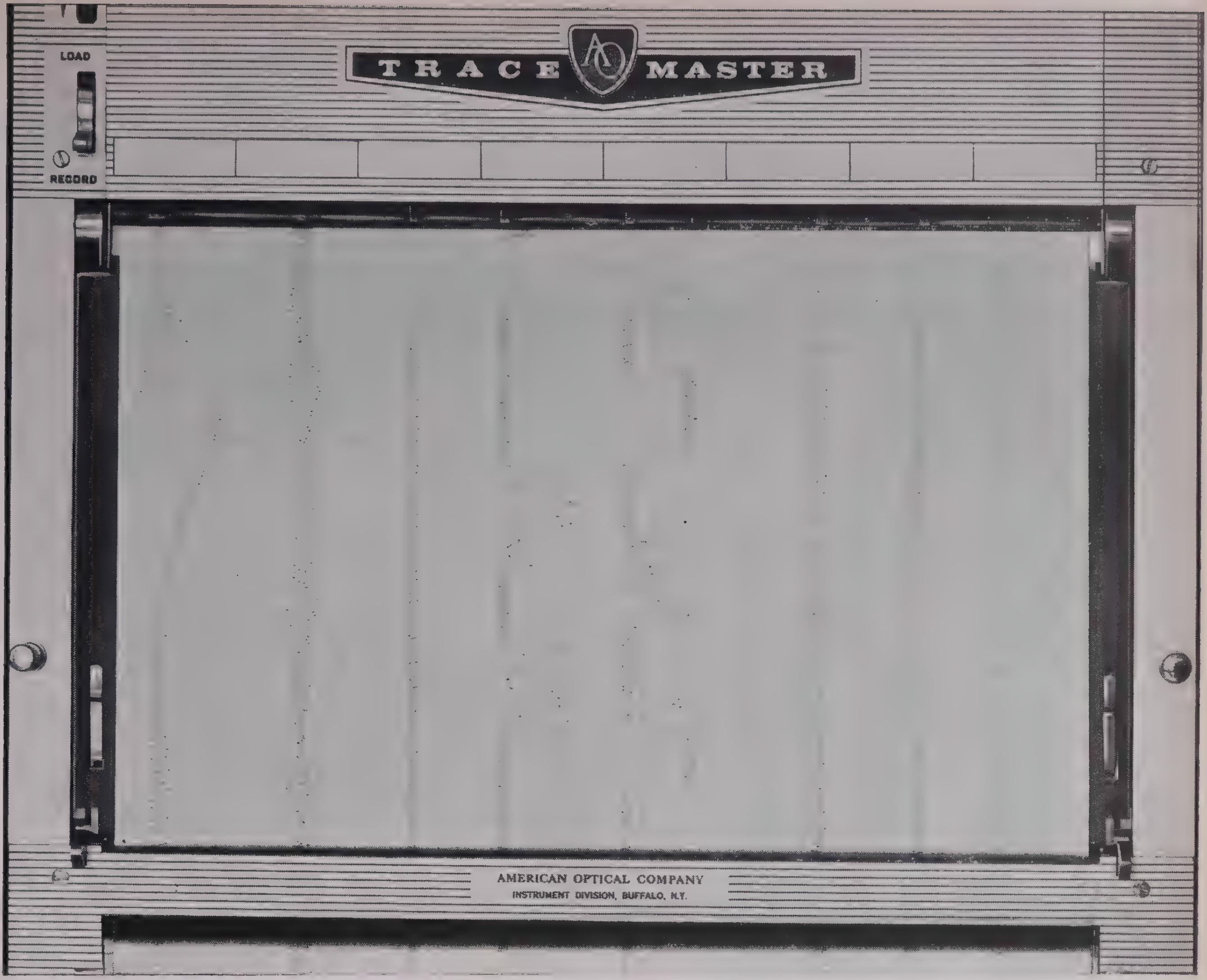

AO Trace-master provides twice the definition of any other direct writing technique

The unique direct-carbon-transfer writing method produces a trace from 2 to 3 times finer than any other direct-writing technique. This allows twice as many lines per millimeter . . . **twice the definition!** Resolution is unsurpassed . . . each line is uniform in width and contrast, revealing the most minute variations in the phenomena measured with utmost fidelity. This writing technique combined with the advanced pen-motor design produces a **wider frequency response at larger amplitudes.** Continuous recording of data can be displayed simultaneously on 8 channels . . . up to 8 independent event markers can be added. Ten chart speeds — 0.1 to 500 mm/sec — provide a 5000:1 chart speed ratio.

The AO Tracemaster has become the new standard of performance for these and many other reasons . . . write now for the full story!

SEE IT AT WESCON . . .
Booths 3707, 3709, 3711, 3713

American Optical
COMPANY

INSTRUMENT DIVISION, BUFFALO 15, NEW YORK

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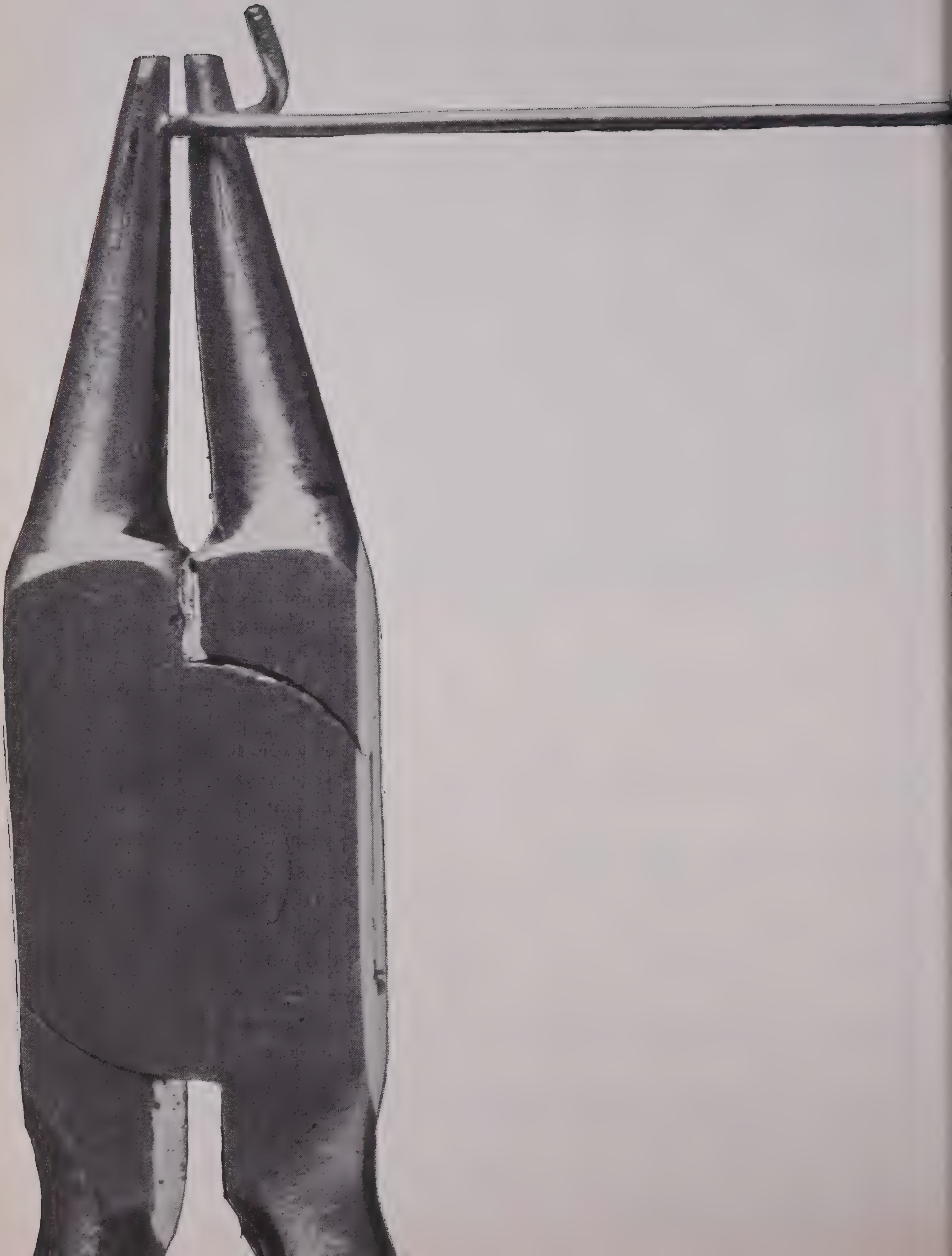
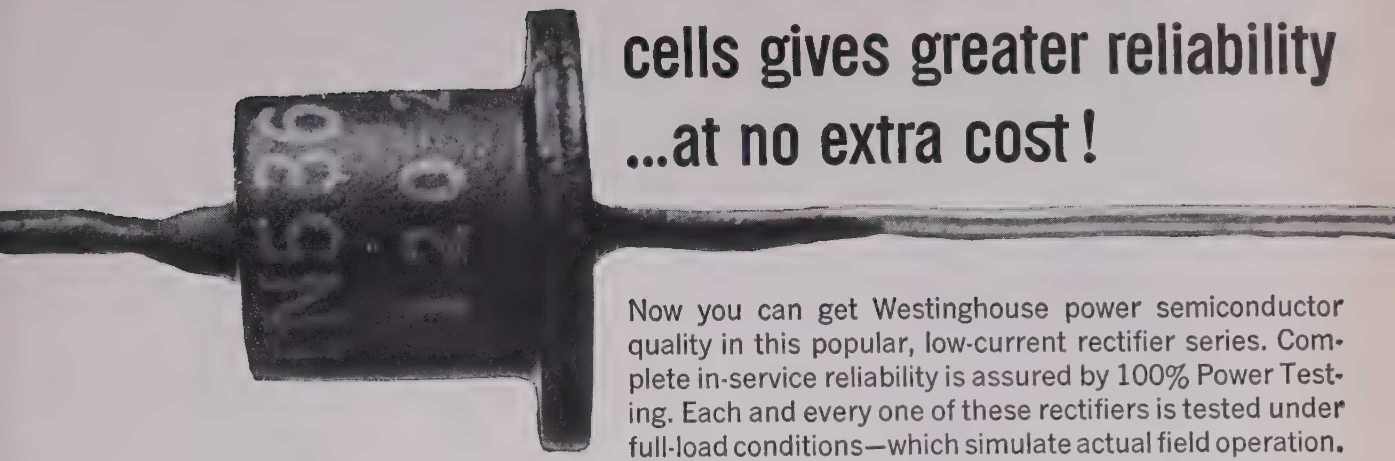


Now! 100% power testing of 1N536-1N561 series rectifier cells gives greater reliability ...at no extra cost!



Now you can get Westinghouse power semiconductor quality in this popular, low-current rectifier series. Complete in-service reliability is assured by 100% Power Testing. Each and every one of these rectifiers is tested under full-load conditions—which simulate actual field operation. This exclusive Westinghouse procedure, developed through years of experience in high-power silicon rectifiers, has resulted in high reliability standards.

Each cell is completely tested under the severest combination of current, voltage, and temperature. Westinghouse gives this assurance of extra reliability, yet the Westinghouse 1N536-1N561 series rectifiers cost no more than other makes.

Features Include: ■ New fused, double-diffused construction ■ Ambient operating temperature minus 65°C to plus 165°C ■ Typical forward drop at 1 amp instantaneous at 25°C—.95 volts ■ Hermetically sealed encapsulation.

The 1N536-1N561 series rectifier cells are immediately available in quantities for all requirements. Why settle for less? Insist on rectifiers which have been 100% Power Tested. Whether the rectifiers you want are large or small . . . You can be sure . . . if it's Westinghouse. SC-1043

For "off the shelf" delivery, order from these Westinghouse Distributors:

EASTERN	
ACK SEMICONDUCTOR, INC.	Birmingham 5, Ala./FA 2-0588
CAMERADIO	Pittsburgh, Pa./EX 1-4000
CRAMER ELECTRONICS, INC.	Boston, Mass./CO 7-4700
ELECTRONIC WHOLESALERS, INC	Melbourne, Florida/PA 3-1441
GENERAL RADIO SUPPLY CO., INC.	Camden, N. J./WO 4-8560
GENESEE RADIO PARTS CO.	Buffalo, N. Y./TR 3-9661
KANN-ELLERT ELECTRONICS, INC.	Baltimore, Md./TU 9-4242
MILGRAY ELECTRONICS	New York, N. Y./RE 2-4400
RADIO & ELECTRONIC PARTS CORP.	Cleveland, Ohio/UT 1-6060
SCHWEBER ELECTRONICS	Long Island, N. Y./PI 6-6520 Silver Spring, Md./JU 5-7023
MIDWESTERN	
E.C.I. SEMICONDUCTORS, INC.	Kansas City, Mo./WE 1-0829
ELECTRONIC COMPONENTS FOR INDUSTRY CO.	St. Louis, Mo./WO 2-9916
HALLMARK INSTRUMENTS CORP	Dallas, Texas/RI 7-8933
INTER-STATE RADIO & SUPPLY CO	Denver 4, Colo./TA 5-8257
LENERT CO.	Houston, Texas/CA 4-2663
MIDLAND SPECIALTY CO	El Paso, Texas/KE 3-9555 Phoenix, Ariz./AL 8-8254 Albuquerque, N. M./CH 7-0236
RADIO DISTRIBUTING CO.	Indianapolis, Ind./ME 7-5571
SEMICONDUCTOR SPECIALISTS, INC	Chicago, Ill /NA 2-8860
S. STERLING CO	Detroit, Mich./BR 3-2900
UNITED RADIO, INC.	Cincinnati, Ohio/MA 1-6530
WESTERN	
ALMAC ELECTRONICS CORP	Seattle, Wash./PA 3-7310
ELMAR ELECTRONICS	Oakland, Calif./TE 4-3311
HAMILTON ELECTRO SALES	Los Angeles, Calif./BR 2-9154 Palo Alto, Calif./DA 1-7541
NEWARK ELECTRONICS CO.	Inglewood, Calif./OR 4-8440

Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa.

Westinghouse

Circle 14 on Inquiry Card

. . . that's a job for Tele-Dynamics

The design, development, and production of solid-state telemetry components and complete systems for aerospace projects are important capabilities at Tele-Dynamics. Today, Tele-Dynamics equipment is recognized for top performance and reliability in a majority of missile and space programs.

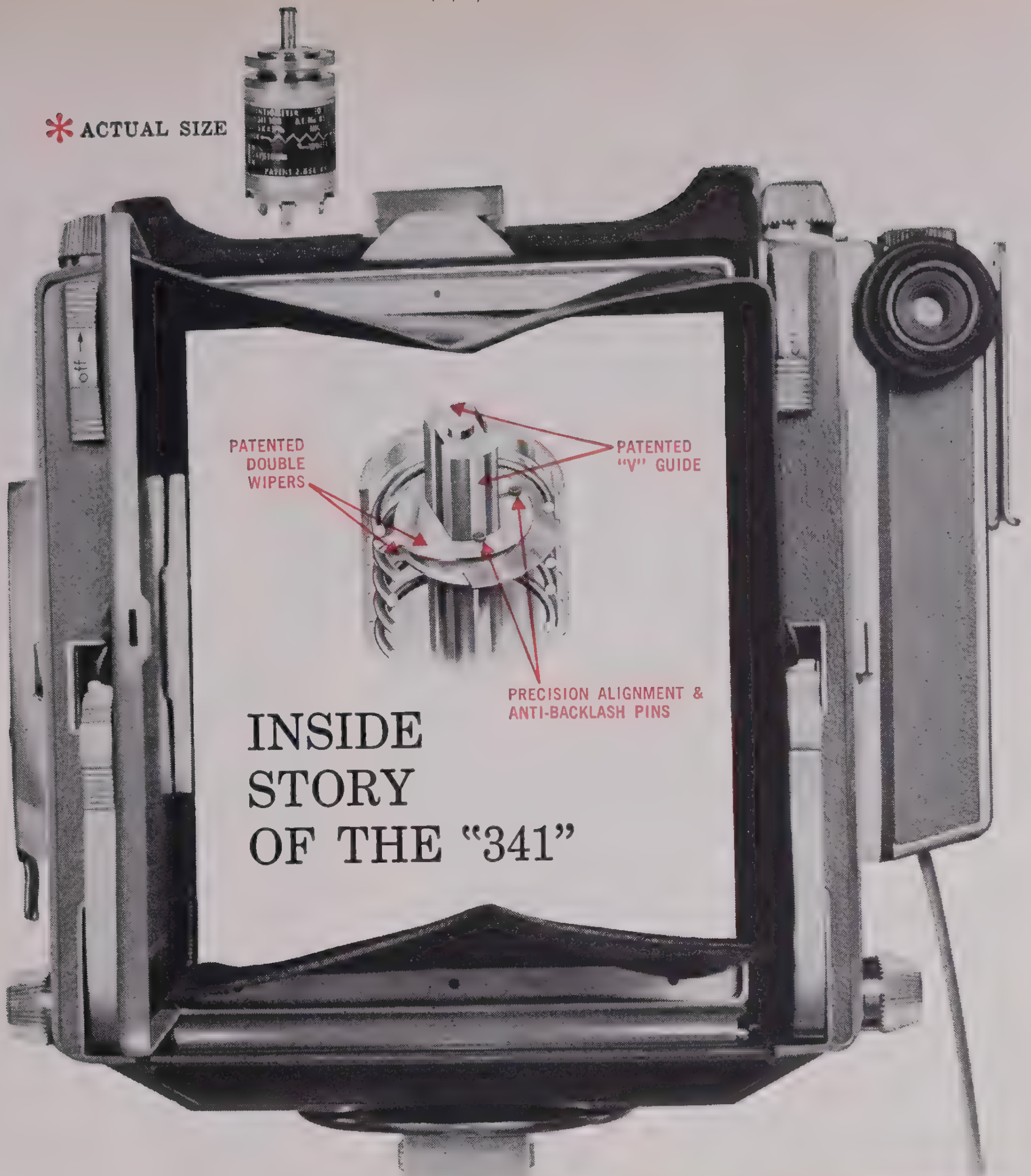
In addition to aerospace telemetry, Tele-Dynamics offers basic knowledge and experience in analog and digital data handling systems, electrostatic recording equipment, instrumentation and systems for underwater and meteorological applications, and electronic support equipment. Tele-Dynamics new capabilities bulletin is now available, write for a copy today. Tele-Dynamics, 5000 Parkside Avenue, Philadelphia 31, Pa.

8434

"Visit us at booth 4126-4128—WESCON SHOW"

TELE-DYNAMICS ***DIVISION***

AMERICAN BOSCH ARMA CORPORATION



INSIDE STORY OF THE "341"

These unique features show why Daystrom 341 Series Potentiometers have zero backlash and maximum resistance to shock and vibration.

Three things make these rotaries unique. (1) : our patented V-guide design which eliminates backlash. (2) : the use of our patented *double* wipers effectively doubles resolution. And (3) : impossible to see with the naked eye, is the winding; the resistive element is wound tightly in a precision groove cut into the mandrel by a tiny diamond tool. As a result, each turn always stays securely in position, despite severe shock and vibration.—▪—Only Daystrom 341 Series rotaries offer these features. Available in values from 1K to 600K, rated at 2.5 watts in *still air*, they are only ½″ in diameter and 1″ long, with or without our patented clutch for servo use. They meet or exceed all applicable MIL specs.—▪—Start solving your potentiometer problems now: contact your Daystrom Representative (or the factory) for more information on specifications, prices, fast delivery.

DAYSTROM, INCORPORATED
POTENTIOMETER DIVISION
ARCHBALD, PENNSYLVANIA • LOS ANGELES, CALIFORNIA

Circle 16 on Inquiry Card

EI's International News

RUSSIA

Russia Buys British Television Equipment

A British color TV camera is to be used in the experimental color television programs now being transmitted from Moscow by the Soviet State Television Service.

V/O Mashpriborintorg, the Russian state purchasing organization for electronic equipment, has ordered the color camera and associated equipment from EMI Electronics Ltd. for approximately $45,000. Other items purchased by Russia from EMI include an outside broadcast vehicle for approximately $140,000, an electronic vibrator and a TV mini-camera which can make observations inside a 3-in. pipe.

The EMI color camera, which will operate 405, 525 or 825 line standard, is particularly compact and easy to use. It employs three vidicon tubes and a novel optical system several times more efficient than conventional relay lens systems.

POLAND

International Ham Station At Poznan Trade Fair

A typical U. S. amateur radio station was on the air as an unusual attraction at the 30th International Trade Fair in Poznan, Poland.

The station is the idea of Telechrome Mfg. Corp., Amityville, N. Y. It is a working model of international cooperation; the Polish government has authorized the company to borrow the call letters of a Poznan amateur operator, SP3KAU, for the duration of the exhibition.

Equipment for the station will include a single-sideband transmitter (Model HX-500) and receiver (Model HQ-180) made by Hammarlund Mfg. Co., Inc., a Telechrome subsidiary.

CANADA

Private Trans-Atlantic Communication Hook-up

A teleprinter communications network linking the North American offices of Aluminum Ltd. of Canada at Montreal, with all of the company's installations in the United Kingdom, was cut over to operation on June 26th.

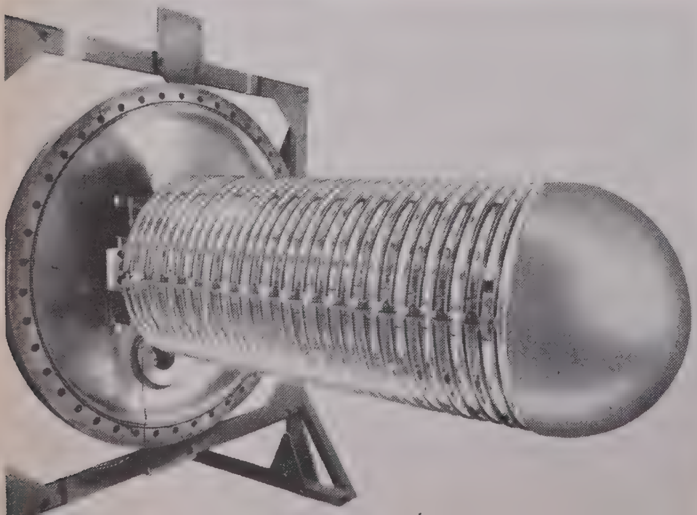
The system was engineered and supplied by Creed & Co. of Croydon, England, an International Telephone & Telegraph Corp. affiliate. Other ITT companies in Europe are working with Alcan in planning installations throughout the continent that will eventually hook-up with the main London switching center and with the North American complex.

PANAMA

New Air Traffic Control System Installed

Lynch Communications Systems Inc., announces a $70,000 sale of the Lynch B1020 remote control electronic monitoring equipment to the Federal Agency for air traffic control in the Panama Canal Zone.

Recent relocation of the station required installation of up-to-date remote control from the air traffic controller position. The narrow band control system permits the controller to select remotely, transmitter frequencies and to perform the push-to-talk functions. The system is a fail-safe expandable control facility requiring 170 cycle bandwidth to perform distance functions. The electronic monitoring system reduces the number of voice circuits required for control between the two locations and assures dependable operation with the smallest possible channel use at a reasonable equipment cost.



Key portion of the Dynamitron electron accelerator is this high voltage generating column which uses parallel fed cascaded rectifier for voltage multiplication. The Dynamitron was invented and produced by Radiation Dynamics, Inc. *(See story at right)*

ITALIAN SHOW

Edward F. Kennedy, brother of the President, examines an electronic aircraft flight simulator at the USA exhibit in the "Italia '61", Italian Centenary Exhibition at Turin. The display was jointly sponsored by several U.S. companies and the Federal Aviation Agency.

FRANCE

Worldwide Network of Atomic Radiation Centers

An International group of research-minded companies including Westrex Corp., a division of Litton Industries, is establishing a world-wide network of irradiation service centers for both scientific research and commercial processing with atomic radiation. Radiation Dynamics, Inc., Westbury, N. Y., are manufacturing the basic equipment for these centers.

The Dynamitron enables commercial producers of mass production items to use radiation for the first time at a cost low enough to be practical. The machine is currently being used for such commercial production as the sterilization of sutures and other pharmaceutical packaged products such as scalpel blades, drugs, and bandages, to pasteurize food products, and to treat plastics in order to enhance their heat-resistance and other resistant properties.

Delivery will be made shortly of the Dynamitron million volt particle accelerator to the new Paris center, another service center will also be established in Tokyo by the end of this year, in an arrangement just consummated with C. Itoh Corp. The Paris center is a joint operation of Leon Adany Research Laboratories of France, Radiation Dynamics, Inc., and Litton Industries' Westrex Corp.

SWITZERLAND

First Foreign Licensee

One of the largest test equipment manufacturers in France has been licensed to make API locking contact meter-relays. The license, first to be granted abroad by the company, covers various patented design features

(*Continued on page* 34)

NEW—MINCOM SERIES G-100 RECORDER/REPRODUCER

Series G-100 Frequency Response
Direct: 200 cps to 300 kc at 60 ips
FM (extended): DC to 20 kc at 60 ips
FM (standard): DC to 10 kc at 60 ips

Building-block construction; card system record/reproduce modules; just twelve moving parts with four easy adjustments; complete plug-in modular design—everything about this new and outstanding Mincom Series G-100 emphasizes its reliable simplicity. Here's an all-purpose magnetic tape system for better performance with improved dynamic range. It's planned for easier operation and maintenance with automatic bias and power supply protection; built-in calibration, plus built-in monitor switching; dynamic braking; all-transistorized electronics; fourteen tracks (analog or FM) in one rack. Covering the bandwidths listed at right, G-100 fills the gap between Mincom's Series CA-100 (125 kc-60 ips) and the Series CM-100 (1.2 mc-120 ips). To discover more of this new system's extra capabilities, write today for complete specifications. See us at WESCON, Booth 1806.

3M COMPANY ... WHERE RESEARCH IS THE KEY TO TOMORROW

MINCOM DIVISION **MINNESOTA MINING AND MANUFACTURING COMPANY**

2049 SO. BARRINGTON AVE., LOS ANGELES 25, CALIFORNIA • 529 PENN BLDG., 425 13th STREET N.W., WASHINGTON 4, D.C.

Circle 17 on Inquiry Card

To Contractors and Subcontractors
on U. S. Government Projects

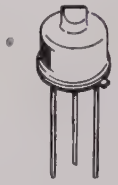
Western Electric offers high reliability semiconductors from Laureldale

- Western Electric's Laureldale, Pennsylvania, plant is now in its ninth year of producing semiconductor devices of ultra-high quality and reliability for government applications.
- Devices designed by a resident Bell Telephone Laboratories group have performance standards exceeding specification requirements which are based on MIL-S-19500B.
- Mechanized production facilities and a comprehensive statistical quality control program assure uniformity and contribute to obtaining ultimate process capabilities.
- Reliability requirements specify 1000-hour elevated temperature life storage tests on all products shipped from Laureldale.

Typical High Reliability Laureldale Semiconductors:

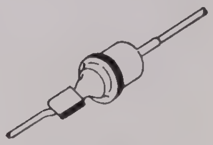
2N559

Diffused Base Germanium p-n-p Mesa Transistor. For ultra-high reliability in large computer systems. Rise times of 1-2 nanoseconds and storage and fall times of 3-4 nanoseconds obtainable.



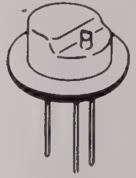
2N1195

Diffused Base Germanium p-n-p Mesa Transistor. Excellent for video or rf applications and as a non-saturating switch. 100 MC gain is ≥ 12 db. Alpha cutoff frequency is ~750 MC.



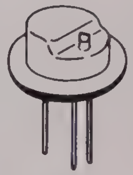
1N696

Diffused Silicon Junction Diode. Outstanding high-speed, low-capacity diode, with a maximum recovery time of 5 nanoseconds and a maximum capacitance of 4 picofarads.



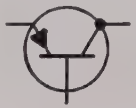
2N1645

Diffused Base Germanium p-n-p Mesa Power Transistor. This transistor is designed to provide 1 watt of power output at 100 megacycles with an efficiency of 50%.



2N1072

Double Diffused Silicon n-p-n Mesa Transistor. This switches a current of 1 ampere with rise and fall times of 50 nanoseconds. The 2N1072 is an excellent core driver.

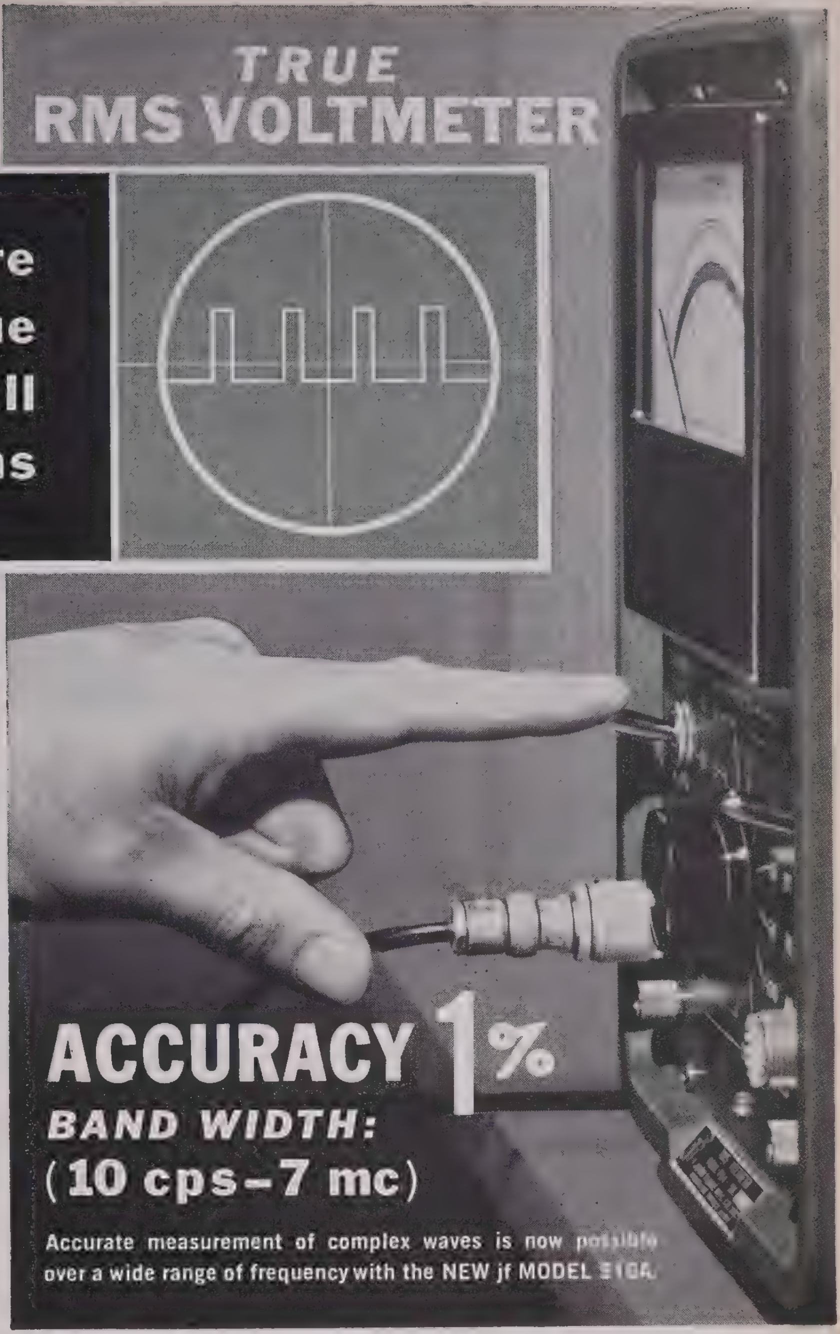


Western Electric and Bell Laboratories have an applications engineering group in residence at Laureldale. The codes shown above (and a complete range of other high reliability semiconductor devices) can be purchased in quantity from Western Electric's Laureldale plant. For technical information on these and other codes, please address your request to Mr. F. A. Mark, Regional Sales Manager, Room 105, Western Electric Company, Incorporated, Laureldale Plant, Laureldale, Pa. Telephone—Area Code 215—WAlker 9-9411.

Western Electric
MANUFACTURING AND SUPPLY BELL SYSTEM UNIT OF THE BELL SYSTEM

Circle 18 on Inquiry Card

ALL-NEW... TRUE RMS VOLTMETER



now . . . measure true RMS value of virtually all waveforms

FLUKE

MODEL 910A

ACCURACY 1%

BAND WIDTH: (10 cps–7 mc)

Accurate measurement of complex waves is now possible over a wide range of frequency with the NEW jf MODEL 910A.

For the *first time* one instrument provides 1% midband accuracy, 10 cps to 7mc bandwidth, plus 100 u v sensitivity. For added versatility an amplifier output is provided for simultaneous oscilloscope or recorder monitoring.

Model 910A employs a thermocouple located in the feedback loop of a sensitive DC amplifier to measure the actual heating effect of the input waveform. This circuit arrangement is the key to the rapid response and high calibration accuracy of the Model 910A and also prevents any error in reading due to ambient temperature variation. Isolation of the thermocouple from the input terminals by a high gain, ultra stable AC amplifier provides high input impedance and completely protects the thermocouple from burnout under any condition of overload.

Model 910A is ideal for measuring AC currents in non linear devices, total harmonic content of distorted waveforms, noise, average power of pulse trains, and other measurements that involve waveforms which are not necessarily pure sinusoids.

Partial Specifications—jf MODEL 910A

Voltage Range:	1 MV to 300V (full scale readings)
Decibel Range:	—72 to +52 dbm
Frequency Response:	10 cps to 7Mc
Accuracy:	± 1% of full scale 50 cps to 800 KC ± 2% of full scale 20 cps to 2Mc ± 3% of full scale 20 cps to 3.5 Mc ± 5% of full scale 10 cps to 7 Mc
Input Impedance:	10 megohms shunted by 30 pf for 0.3 volt range and below. 10 megohms shunted by 15 pf for 1.0 volt range and above.
Crest Factor:	3 at full scale, proportionately higher for readings less than full scale.
Price:	Cabinet Model—$545.00 Rack Model—$565.00 Prices f.o.b. factory.

Prices and data subject to change without notice.

A more complete description will be sent to you upon request.

FLUKE

JOHN FLUKE MFG. CO., INC.
P. O. Box 7428 Seattle 33, Washington

Circle 19 on Inquiry Card

WIDER

RANGE WITH GREATER ACCURACY!

This Vought Electronics Servo Analyzer is an *all-electronic* instrument covering the dynamic range of most servo systems *without* the troublesome maintenance requirements of mechanical multipliers.

Modulation rates of .005 to 1000 cps in five ranges are provided in sinusoidal, step, and ramp functions either directly or in suppressed carrier form. Modulation frequency accuracy readings of 2% are possible.

Other important unit specifications are:

- carrier frequency range of 50 to 10,000 cps
- carrier phase shift of less than 2° to 5 kc
- signal attenuation of 0 to 99 db in 0.1 db steps
- phase measurement accuracy of 2°

Use of Vought Electronics Servo Analyzer has been demonstrated successfully with *Titan* and *Minuteman* missiles as well as in industrial laboratory applications. It is available in both bench and rack mounted models.

For more complete information about this versatile instrument, contact:

Chief of Product Sales
Chance Vought Electronics Division
P. O. Box 1500, Arlington, Texas

CHANCE VOUGHT ELECTRONICS

ANTENNAS • AUTOMATIC CONTROLS • NAVIGATIONAL ELECTRONICS • GROUND SUPPORT ELECTRONICS

Circle 20 on Inquiry Card

International News

(*Continued from page* 30)

and circuits, according to John D. Saint-Amour, President, Assembly Products Inc. The licensee is Compagnie Generale de Metrologie ("Metrix"), of Annecy, 30 miles from Geneva, Switzerland.

AUSTRIA

Space Age Metals and Temperature Problems

At the Fourth Plansee Seminar, held recently in Reutte, Tyrol, a special session was devoted exclusively to high melting metals and their production, which determine their physical and chemical properties. Mr. George C. Deutsch of the Headquarters of the National Aeronautics and Space Administration in Washington, D. C., stated that the strength of these materials at elevated temperature is no longer sufficient for space vehicles.

One of the basic needs for many of the materials for space vehicles is that they must withstand the high temperature of the propellant and reentry temperatures. High melting metals, such as tungsten, molybdenum, tantalum and niobium must be used, but the strength of even these metals is not sufficient at elevated temperatures.

Beryllium, which is considerably lighter than aluminum, but of a much higher melting temperature, is one of the materials which will play an important role in space vehicles development. At the Fourth Plansee Seminar several speakers from England and France disclosed latest developments of beryllium metal, its fabrication and properties.

W. GERMANY

German Firm Doubles Sales by Research

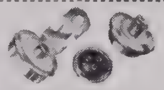
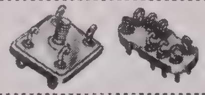
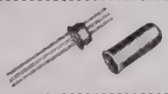
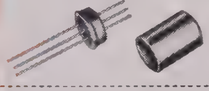
Henschel-Werke G.m.b.H. of Kassel, West Germany, one of West Europe's leading manufacturers of capital goods, expects sales to climb to $125 million this year, an increase of 25% over 1960, it was announced yesterday in New York City. The number of employees surpassed 13,500 as against 8,000 in 1959.

Henschel-Werke was completely reorganized in 1958. Special research departments were added, which today employ more than 800 scientists and engineers. As a result of this drastic change, sales began to climb from $33 million in 1957 to $100 million in 1960, and for the current year a 25% increase is foreseen. Diesel engines, plastic processing machines, steam generators and machine tools currently represent Henschel's largest sales contingent.

VISIT BOOTH 3005 AT
THE WESCON SHOW!

...tough going ahead!

E-I
GLASS-TO-METAL
SEALS

DESIGNED	INDIVIDUAL TERMINALS	COLOR CODED TERMINALS 
FOR THE	MULTI-LEAD TERMINALS	CONDENSER END SEALS
SPACE	THREADED SEALS	CUSTOM SEALS 
AGE	MINIATURE CLOSURES 	TRANSISTOR CLOSURES 

Utmost reliability is assured under severest environmental conditions. E-I Glass-to-Metal Seals have proven their ability to withstand extremes of temperature, high mechanical shock and vibration, and wide pressure changes in thousands of critical commercial and military applications.

E-I offers a Complete Line of economical standard seals, facilities for designing special seals and custom service for the sealing of components of your own manufacture. Call or write for literature or recommendations on your specific sealing problems.

ELECTRICAL INDUSTRIES

Patented in Canada, No. 523,390; in United Kingdom, No. 734,583; licensed in U. S. under No. 2561520

MURRAY HILL, NEW JERSEY
A Division of Philips Electronics & Pharmaceutical Industries Corp.

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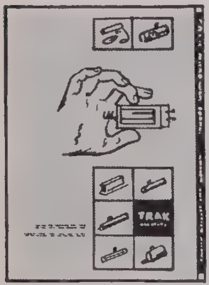


TRAK MICROWAVE offers a complete line of microwave energy sources including oscillators, amplifiers and harmonic generators. Write for Catalog 61-A.
See our WESCON display — Booth 2117; ISA display — Booth 501.

Microwave projects, impossible before, are now possible with these new sub-miniature Trak microwave oscillators. Limited quantities of developmental models now available.

TRAK TYPE 9180 Size: ⅜″ long by ¾″ diameter, excluding projections. Frequency: plate pulse, 4.5 KMc to 6 KMc; CW service, 4.0 to 5.5 KMc. Tuning range is limited to approximately 100 megacycles.

TRAK TYPE 9181 Size: 1½″ long by 9/16″ diameter, excluding projections. Frequency: CW service, 5.0 KMc to 6.0 KMc with tentative tuning range of 400 megacycles.

Consider the possibilities of these new oscillators, then phone us collect about projects you have in mind.

TRAK® Microwave

TRAK MICROWAVE CORPORATION

5006 N. Coolidge Avenue   Tampa 3, Florida
PHONE: REdwood 6-6422 or REdwood 6-6407

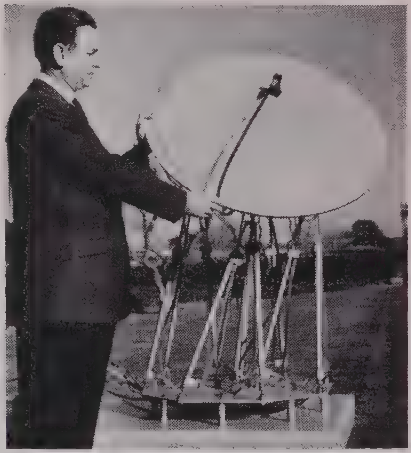
Specialists In Miniature Microwave Energy Sources

As We Go To Press (cont).

Foam Reflector Used on Antenna

An antenna, composed of a lightweight rigid foam reflector and an antenna positioning device which can move the reflector through any angle of reference has been developed by the Electronic Defense Laboratories of Sylvania Products, Inc., Mountain View, Calif.

The Antenna Positioning Device (ANPOD) uses linear motion to support and position the reflector. The twelve legs are long hydraulic cylinders grouped into four tripods. Coordinated changes in the length of the legs controlled by a servo-mechanism cause the antenna to move through any desired search or track pattern.



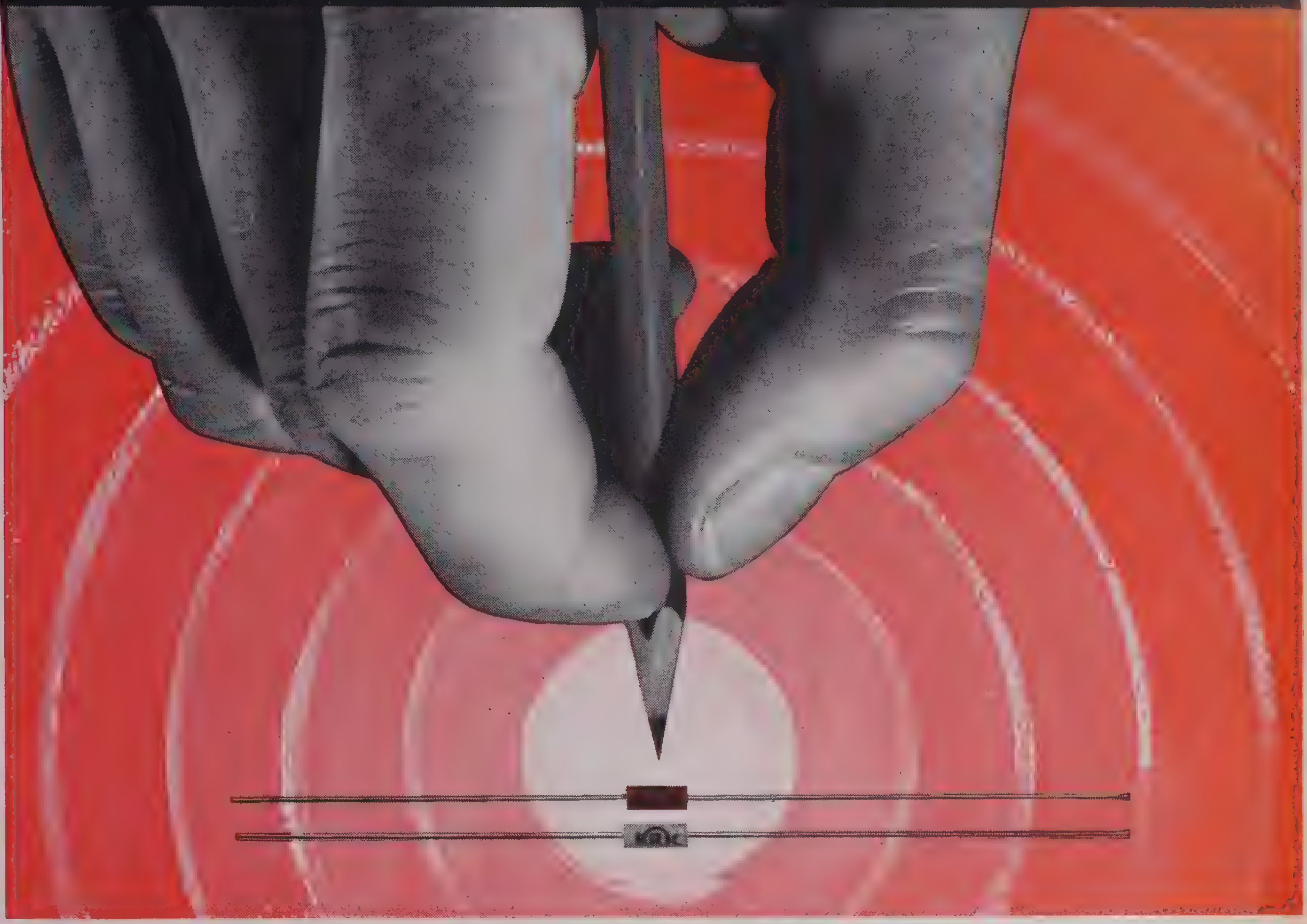
Mack Suliteanu, EDL engineer who developed the antenna system, is shown pointing out antenna's feed horn buried in its foam surface.

Federal Aviation Agency Proposal

The Federal Aviation Agency has proposed that aircraft operating in positive control areas be required to carry a radar beacon transponder that can transmit coded identification signals to a ground radar beacon receiver. Under present rules, aircraft must be equipped with a radar beacon transponder to operate in positive control areas.

At present, there is only one positive control area in which the requirement would apply — the airspace from 24,000 to 35,000 feet covered by long range radar from Chicago, Indianapolis, and New London, Ohio. It would not apply to aircraft operations on the three positive transcontinental airways between 17,000 and 22,000 feet.

In PRECISION FILM RESISTORS if it's news, expect it first from IRC



Industry First...RN55 Precision Film Resistors in RC07 Size

Replace Fixed Composition Resistors

Every critical circuit forced to attain smallness through use of RC07 style composition resistors can now be upgraded. To make this possible, IRC offers both metal film and deposited carbon precision resistors in a new subminiature size.

1. the first time a molded RN55 resistor is available completely interchangeable in physical size with the RC07
2. meets or exceeds performance of precision films (MIL-R-10509), which means lower noise, better TC, superior all-around stability than fixed composition RC07's (MIL-R-11)
3. surpass RC07's even when run at the MIL-R-11 rating of ¼ watt @ 70° C
4. uniform, molded bodies just right for automated assembly . . . immune to damage by normal transit and handling

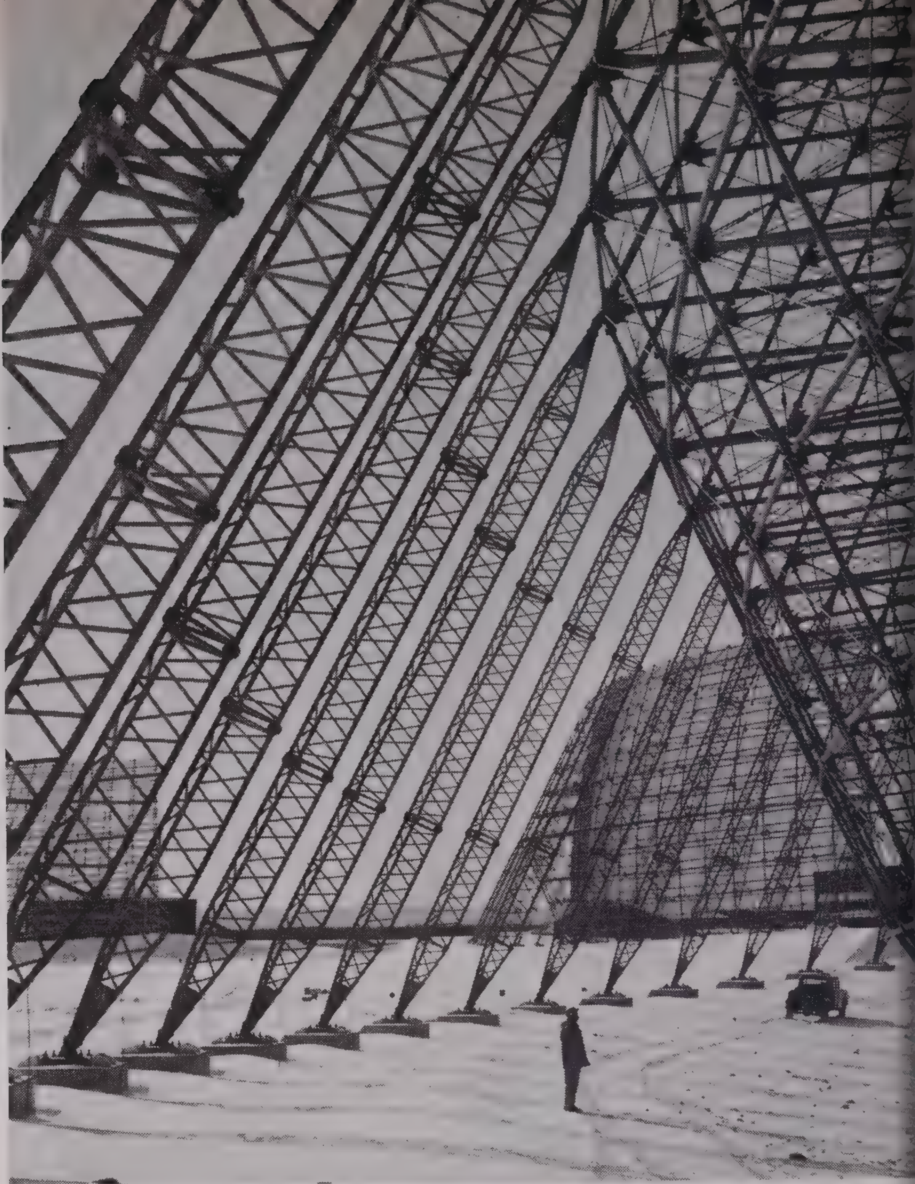
For top resistor performance without any space penalty, specify new IRC Type EM or DM units for every miniature circuit. Full details in a new 12-page bulletin. International Resistance Company, 401 North Broad St., Philadelphia 8, Pennsylvania.

CAPSULE SPECIFICATIONS

	Metal Film	Deposited Carbon
Wattage	1/10 watt @ 125 C derated @ Zero load @ 175 C	1/10 watt @ 125 C ⅛ watt @ 70 C derated @ Zero load @ 165 C
Temperature coefficient	± 25 PPM ("E" Char.) ± 50 PPM ("C" Char.) ± 100 PPM ± 150 PPM	+200/—500 PPM ("D" Char.)
Resistance	50 ohms min. 100K ohms max.	10 ohms min. 301K ohms max.
Standard tolerance	± 1%	± 1%
MIL-R-10509D	RN55 Characteristic E and C	RN55 Characteristic D
Size	.250″ ± .031″ x .093″ ± .005″ dia.	.250″ ± .031″ x .093″ ± .005″ dia.
IRC designation	EM	DM

Circle 23 on Inquiry Card

Snapshots... of the Electronic Industries

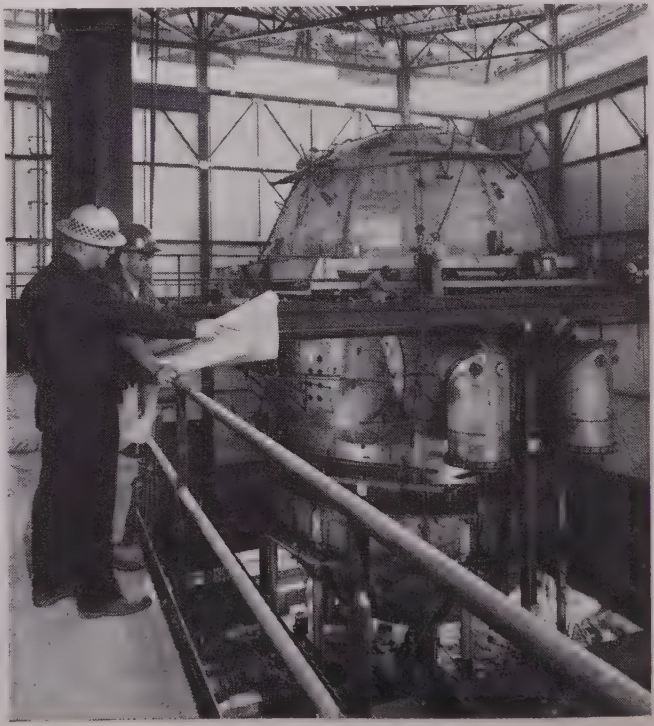


BMEWS REFLECTORS

Steel latticework backstays which support radar antenna reflectors at the USAF's Ballistic Missile Early Warning Station at Clear, Alaska, dwarf specialist John Farrell. G. E. built radars use mammoth reflectors measuring 165 feet high and 400 feet wide.

THIN-FILM TRANSISTORS

Staff member at RCA, Princeton, N. J. examines enlarged test unit of an ultra-miniature transistor which can be made so small that 20,000 would fit on a postage stamp.



SPACE SIMULATORS

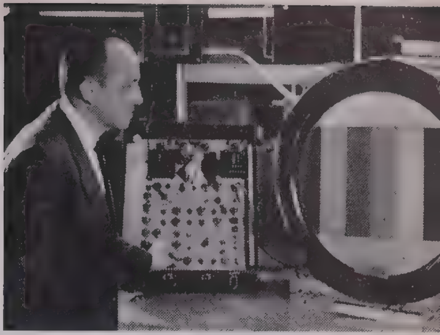
Space simulator large enough to test actual manned space vehicles nears completion at the future G. E. Co's Valley Forge, Pa. Space Technology Center.

"SPINNING WHEEL"

Technician Arthur Harris checks over one of eighteen wire spools on part of a twenty-five foot long planetary wire-stranding machine at the Van Nuys, California plant of Lockheed Missiles and Space Division.

SHOCK-RESISTANT RADOMES

Radomes made of high strength plastic protect microwave antennas at Fairchild Air Force Base, Spokane, Wash. Underground concrete bunker contains racks of equipment made by Collins Radio Co., Dallas, Texas.

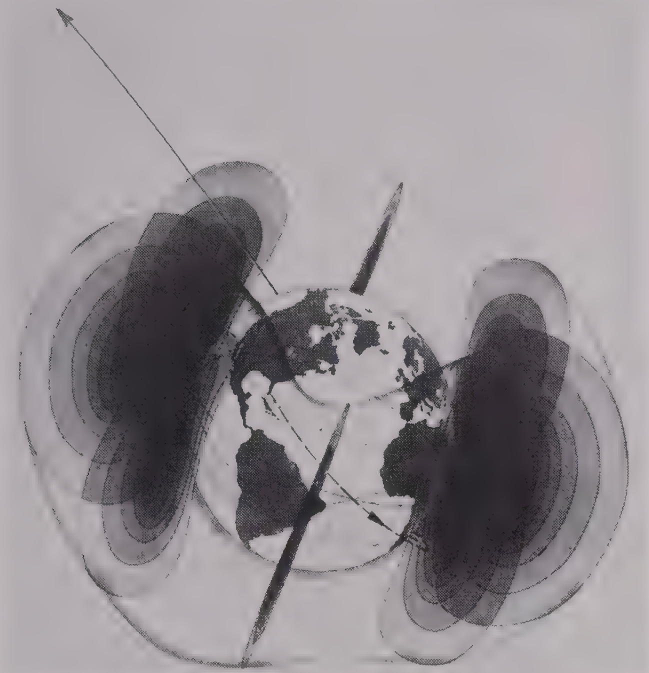


COLOR BAR GENERATOR

Chief engineer Walter J. Cerveny makes adjustment on NTSC Standard Color Bar Generator. Made by the Hickok Electrical Instrument Co., Cleveland, Ohio, it produces a pattern of seven colors on a TV screen.

SUN-POWERED CART

Solar cells beside cart were used to charge batteries of cart driven by H. L. Hoffman, president of Hoffman Electronics Corp., Los Angeles, California.



VAN ALLEN RADIATION BELT

Space vehicle trajectory plotted to avoid most of the belt, along with The Martin Company's (Baltimore, Md.) finding that the shell of a space ship and its equipment arrangement can furnish adequate protection, will help alleviate radiation hazard to space ship crews.

SUNLIGHT CONCENTRATORS

Solar cells are mounted on a Somor concentrator, which is oriented to face the sun. Studies conducted by The Boeing Co., of Seattle, Washington, on the haze-free slopes of Washington's Mt. Rainier have produced sunlight intensity of more than 100 watts a square foot.

MOBILE LABORATORY

Fifty-five foot long trailer has 5 environmentally controlled rooms for on-site cleaning of missile propellant systems components. Three center rooms are pressurized with air filtered to 5 microns. They connect with end rooms through air locks. Unit is made by Wyle Laboratories, El Segundo, Calif.

zero temperature coefficient capacitors

INSENSITIVE to TEMPERATURE CHANGE!

The temperature coefficient of ARCO Type H capacitors is ZERO ±15 ppm/°C. throughout the full temperature range of −55 to +85°C. Capacitance values available are from .001 mfd. to in excess of one microfarad. Enclosed in both tubular and bathtub hermetically sealed containers, Type H capacitors exhibit electrical excellence and physical strength which make them adaptable for use in the most critical of military or industrial circuitry. Please write us for further details.

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Tele-Tips

INVESTIGATION of a TV interference case in Alaska disclosed that a CATV system had installed a broadband oscillator on one of its cable-carrying poles in an effort to thwart holders of free-TV sets from tuning in the pay-TV programs which leaked from the cable. The CATV stopped its "jamming" but was given an official warning.

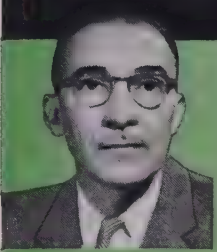
ENGINEER IS NAMED to medical faculty. The Univ. of Saskatchewan has appointed a professional engineer to its medical faculty. He will coordinate research projects of interest to both faculties.

THE EFFECTS of wave polarization on radio direction finding were emphasized when a San Francisco FCC field engineer was called upon to locate an idle carrier on a frequency used by a cab company. Reflections from steel buildings confused signal strength readings of the FCC mobile unit and loop direction finder bearings did not lead to location of the trouble. However, by rigging up a special antenna, the engineer was able to follow the signals to a Navy installation. There a transmitter was found to have a defective crystal, which was quickly replaced.

WHEN CURIOUS spectators asked a group using telescopes and radio transmitters on a Florida beach what was going on they were told by a man with a beard and a foreign accent that radio signals were being received from Jupiter. Suspicious persons informed the FCC Savannah field office. A visit by one of the latter's engineers found a class of students studying celestial navigation and synchronizing their observations with time signals from the Naval Observatory. Members explained that their work had been interrupted by so many silly questions that they were giving silly answers.

(*Continued on page* 44)

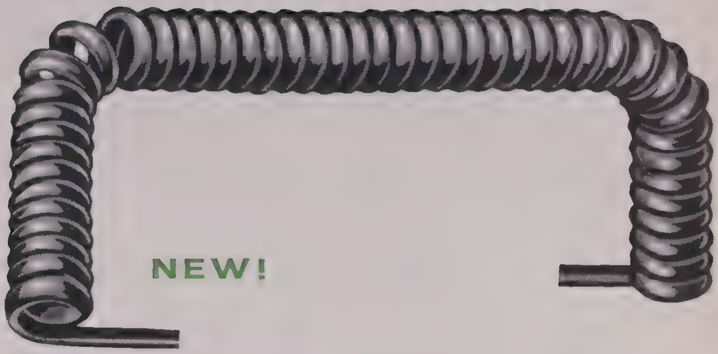
NEW
from Belden
for the
WESCON
SHOW



Frank Timmons

**See us in
Booth 4612-4614**

Frank Timmons, Belden Electronic Standards Engineer, will again be available for consultation and to help you with your specifications.



NEW!

COILED RETRACTILE CABLES
Microphone—Telephone

A variety of new types and lengths for most applications. Microphone cables offered with 1, 3, and 4 conductors in vinyl and neoprene—telephone cords with 3 and 4 conductors, vinyl only.

NEW! HOOK-UP WIRE
Complete Range of New Mil-Spec Numbers

new!
Mil-W-76B-Plastic
MW-Vinyl-1000V-80C
MW-Shielded-1000V-80C
MW-Shielded-Nylon Jacket-1000V-80C
MW-Glass Braid-1000V-80C
MW-Glass Braid-Shielded-1000V-80C
MW-Nylon Jacket-1000V-90C
HW-Vinyl-Gauges 16-22 2500V Gauges 6-14 -600V-80C
HW-Glass Braid-600V-80C
LW-Vinyl-300V-80C
LW-Nylon Jacket-300V-90C

new!
Mil-W-16878D-Plastic
B-Vinyl-600V-105C
B-Vinyl-Nylon Jacket-600V-115C
C-Vinyl-1000V-105C
C-Vinyl-Nylon Jacket-1000V-115C
D-Vinyl-3000V-105C

new!
Mil-W-5086A & Mil-C-7078A Aircraft Power and Lighting Cables
Mil-W-5086A-Types 1 & 2-600V
Mil-C-7078A-Type 1-600V

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SINCE 1902 — CHICAGO

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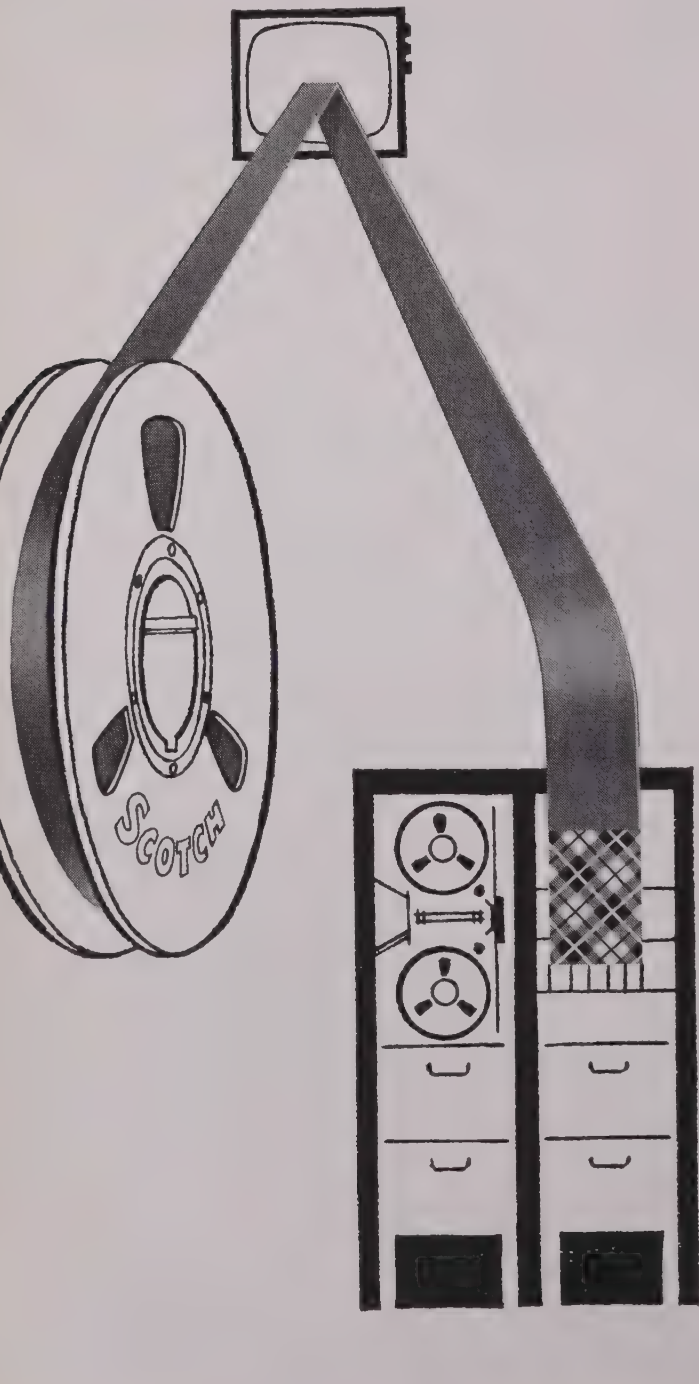
8-8-1

THE TAPE THAT CHANGED TV FOR ALL TIME

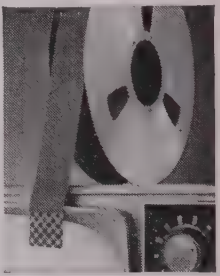
leads you right to rugged SCOTCH® BRAND Heavy Duty Tape



The tie that binds television's top performer to instrumentation tape is strong—and it goes beyond the fact that the same expert team produces the best of both. "Scotch" brand Heavy Duty Tapes share a common heritage—and uncommon endurance—with "Scotch" brand Video Tape, the tape that puts a network TV show on the same "clock time" from Maine to California.

Similarities worth noting between the two: a similar high-temperature binder system, famous "Scotch" brand high potency oxides, a similar ability to resist tremendous speeds, pressures and temperatures while providing high resolution.

Let's look at the record of "Scotch" brand Video Tape and see what message it has for the user of instrumentation tape. On a standard reel of video tape like that shown here, some 1½ million pulses per second must be packed to the square inch—on a total surface area equal to the size of a tennis court. The tape must provide this kind of resolution while defeating the deteriorating effects of high speeds, pressure as high as 10,000 psi and temperatures up to 250°F.



The fact is that video tape must be essentially perfect. And it's a matter of record that thus far only the 3M experts have mastered the art of making commercial quantities of video tape that consistently meet the demands of the application.

Significantly, the high-temperature binder system developed for "Scotch" Video Tape is first cousin, only slightly removed, to that used in the Heavy Duty Tapes. It's this special feature that has given Heavy Duty Tapes their exceptional wear life.

The moral emerges: for tape that provides the best resolution of high and low frequencies under the severest conditions, turn to "Scotch" brand Heavy Duty Tapes 498 and 499.

They offer the high temperature binder system, plus the same high quality and uniformity that distinguish all "Scotch" brand Tapes. As the most experienced tape-makers in the field, 3M research and manufacturing experts offer tape of highest uniformity—from reel to reel and within the reel. Check into the other "Scotch" brand constructions: High Resolution Tapes 457, 458 and 459; High Output Tape 428; Sandwich Tapes 488 and 489; and Standard Tapes 403 and 408.

Your 3M Representative is close at hand in all major cities. For more information, consult him or write Magnetic Products Division, 3M Co., St. Paul 6, Minnesota.

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SCOTCH BRAND MAGNETIC TAPE

FOR INSTRUMENTATION

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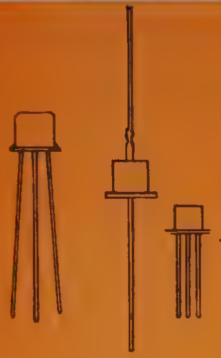
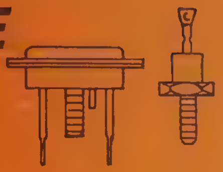


MOTOROLA MIL-TYPE



SEMICONDUCTORS

for the military equipment designer looking for a complete, single source of reliable, field-proven transistors, rectifiers, and diodes

With its line of Mil-type semiconductor devices continually expanding, Motorola now offers 84 high reliability devices of the "preferred" types as well as many "guidance" types listed by the Department of Defense. This comprehensive selection includes power transistors, milliwatt transistors, rectifiers and zener diodes.

In addition to the quality proven by their ability to meet stringent military tests, many of these devices have proven their reliability in such major missile systems as the Minuteman, Polaris, Atlas, Nike-Zeus and others. Also, Motorola is the first to offer military users components that were developed to meet the high reliability requirements of the Minuteman program. These are the 101 and 201 Mesa switch and amplifier types.

If you are working on military equipment, we suggest you call your local Motorola representative for further information on the types listed below as well as other types that are presently being tested to the appropriate military specifications.

LISTED BELOW ARE SOME OF THE MORE POPULAR LINES OF MOTOROLA MIL-TYPE TRANSISTORS, RECTIFIERS AND SILICON ZENER DIODES.

POWER TRANSISTORS

2N174 (JAN)
2N297A (SIG. C)
2N1011 (SIG. C)
2N1120 (SIG. C)
2N1358 (SIG. C)
2N1412 (USN)

MILLIWATT TRANSISTORS

2N331 (JAN)
2N461 (USAF)
2N465 (SIG. C)
2N466 (JAN)
2N467 (SIG. C)

MESA TRANSISTORS

2N700A (SIG. C)
2N705 (USN)

SILICON RECTIFIERS (JAN)

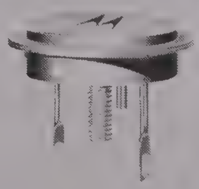
1N253
1N254
1N255
1N256
1N538
1N540
1N547

SILICON ZENER DIODES (SIG.C)

1N2970B
1N2971B
1N2972B
1N2973B
1N2974B
1N2975B
1N2976B
1N2977B
1N2979B
1N2980B
1N2982B
1N2984B
1N2985B
1N2986B
1N2988B
1N2989B
1N2990B
1N2991B
1N2992B
1N2993B
1N2995B
1N2997B
1N2999B
1N3000B
1N3001B
1N3002B
1N3003B
1N3004B
1N3005B
1N3007B
1N3008B
1N3009B
1N3011B
1N3012B
1N3014B
1N3015B

Reverse polarities (suffix RB) are available in all zener diodes listed.

ANNOUNCING another superior Motorola Mil-type semiconductor - The 2N1412 (USN)



Motorola's new 2N1412 (USN), produced to the requirements of MIL-S-19500/76A, is the first Mil-type power transistor offering a collector voltage of 100 volts. This husky Motorola unit dissipates a full 150 watts, and its thermal resistance (0.5°C/W max) enables it to run cooler for increased circuit reliability and longer life.

In addition, the Motorola 2N1412 (USN) is rated for 100°C continuous junction operation and its "low silhouette" TO-36 case requires far less headroom than conventional TO-36 packages. It's ideal for application in high-power, high-efficiency amplifier and switching circuits, and in most cases will replace the commercial 2N1100.

MOTOROLA IS YOUR MOST COMPLETE SOURCE FOR HIGH-RELIABILITY MIL-TYPE SEMICONDUCTORS

For complete technical information on any of Motorola's Mil-type units, phone your Motorola Semiconductor District Office:

Belmont, Mass., IVanhoe 4-5070/**Burlingame, Cal.**, DIamond 2-3228
Chicago, Ill., AVenue 2-4300/**Clifton, N. J.**, GRegory 2-5300
Dallas, Tex., LAkeside 6-8931/**Dayton, Ohio**, AXminster 3-4164
Detroit, Mich., BRoadway 3-7171/**Glenside, Pa.**, TUrner 7-7020
Hollywood, Cal., HOllywood 2-0821/**Minneapolis, Minn.**, LIberty 5-2198
New York, N. Y., WIsconsin 7-2980/**Philadelphia, Pa.**, WAverly 7-6144
Phoenix, Ariz., 273-6364/**Silver Springs, Md.**, JUniper 5-4485
Syracuse, N. Y., GRanite 4-3321/**Winter Park, Fla.**, MIdway 7-2507
Toronto, Ont., PLymouth 9-2222

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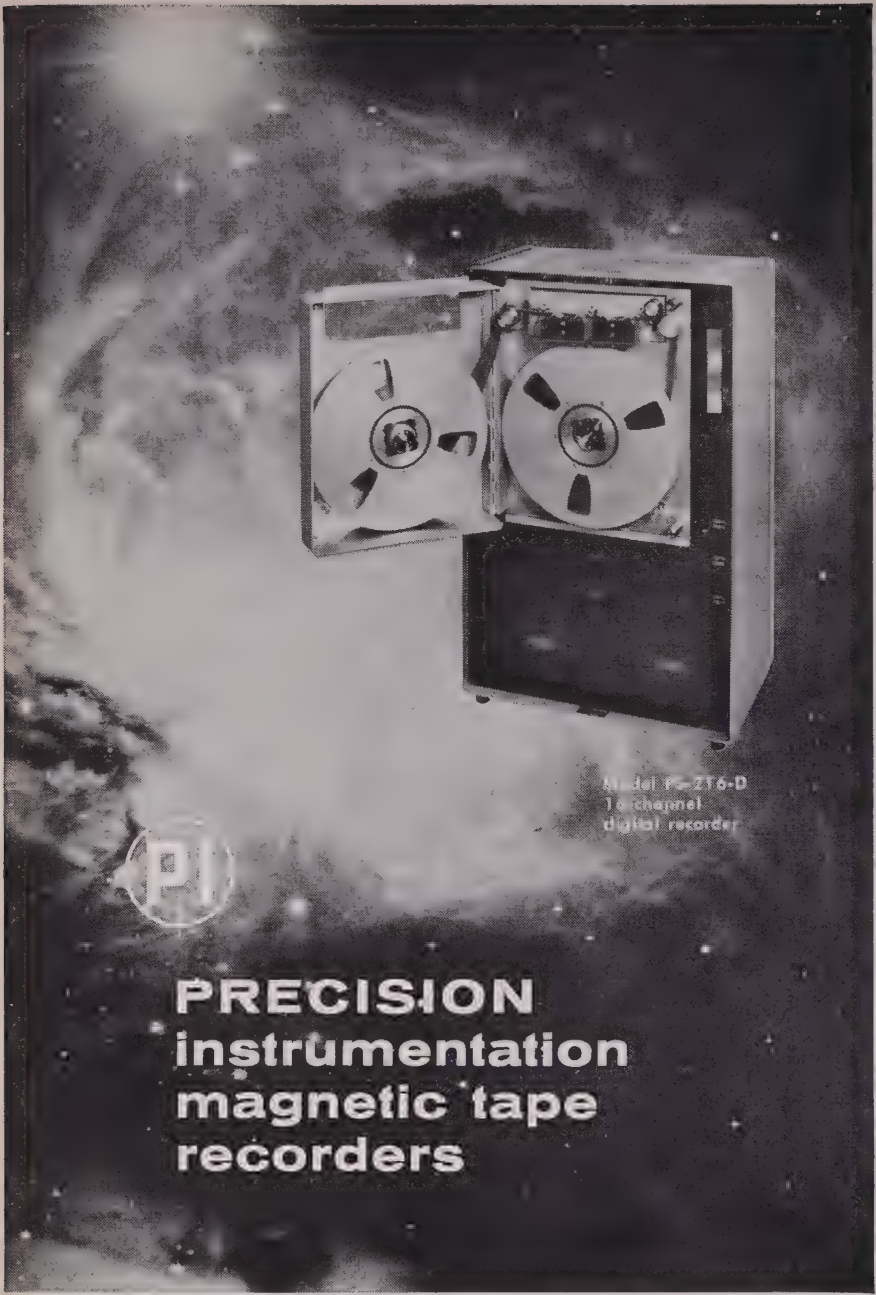
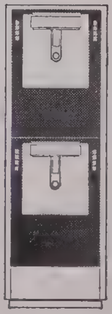


for space-conscious applications

PRECISION recorders are fast becoming the standard for the most critical and demanding applications in the age of space. Advanced mechanical concepts and solid-state circuitry provide full-size performance **in less than ¼ the space** required by conventional recorders. Up to 14 channels of analog or 16 channels of digital recording in a wide range of models for rack mounting or portable use. Write for detailed new brochure #55A.



Two complete 14-channel P.I. recorders require only 51″ of rack space

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REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

Tele-Tips

(Continued from page 40)

A PIANO FACTORY struck the wrong note twice in interfering with aviation radio communication. Two months after they had corrected a defective electronic heater which leaked emissions on a frequency used by a Chicago airline terminal, an Air Force installation in the same area complained of like interference. This time it was a different heater. The factory is now using only heaters certified as complying with the Commission's rules to curb radiation.

A manufacturing company complained of disruption of communication on an industrial radio frequency. It specifically blamed another station 20 miles away. Inquiry showed that the complainant was indeed correct, but what it did not seem to know was that both stations were operated by the same firm. The problem was settled internally.

SESQUIPEDALIAN. This means, "Given to using long words." Now we know what to call some of our blue-sky engineering article contributors.

PULSE-TYPE INTRUSION on a citizens communication channel was reported to the Los Angeles field office. An engineer in an investigative car took bearings which fixed the source in mountains north of the city. The trail led up narrow, winding roads to an elevation of 6,500 ft. On arriving at the target the engineer found a citizens remote-control transmitter atop a water tower. It was controlled by the water level of the tank and transmitted pulses to activate a water pump three miles away when the water went below a certain level. The installer made adjustments which eliminated the interference.

**"Letters to the Editor"
begin on page 53**

8036 SMALL, RUGGED CERAMIC HYDROGEN THYRATRON SAVES VALUABLE SPACE

Tung-Sol leads the way with a ceramic Hydrogen Thyratron that fills an important design need. An electrical equivalent of the popular Tung-Sol 5949A — only one third tube volume is required by this new member of the family.

Tung-Sol ceramic Hydrogen Thyratron 8036 has rugged environmental ratings. It is designed for flange mounting with flexible connectors to achieve a solid mounting with lossfree terminations. Grid connection is made to the flange through the grid ring clamp.

For full technical data, consult your Tung-Sol representative or write: Tung-Sol Electric Inc., Newark 4, N.J. TWX:NK193.

HYDROGEN THYRATRON 6587A

6587A, a glass thyratron, is a direct plug-in replacement for Tung-Sol 5C22. Valuable inches of overall height are saved by means of the ring-disk type of construction, which also provides the advantages of external (cool) anode and lower lead inductance. It is rated for higher voltages with higher currents than prototype tubes. Grid connection can be made through the grid ring or through the tube base pin. An internally-connected hydrogen reservoir promotes long life.

	8036	6587A	5C22
Overall height, Max	3.75"	6.	8.75
Peak forward voltage	25. KV	18.	16.
Peak current	500. Amps	365.	325.
Peak Pulse Power (Delivered to the load)	6.25Mw	3.25	2.6

TECHNICAL ASSISTANCE IS AVAILABLE THROUGH: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. In Canada: Abbey Electronics, Toronto, Ont.

ts TUNG-SOL®

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Do you have any of these transient analysis problems?

Development of a unique new instrument—the Hughes High-frequency Memo-scope® Oscilloscope—now makes solving transient analysis problems quicker, easier and more economical. Secret of this instrument is its ability to freeze high frequency impulses until intentionally erased. It is the only instrument on the market today that can give you stored response at fast writing speeds! Here are six case histories which demonstrate the types of problems which can be solved:

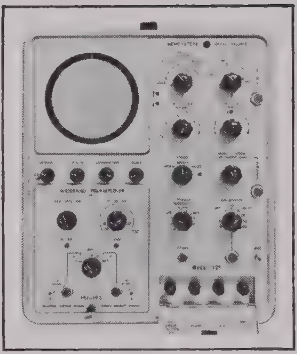
Low Level Signal Data Processing—A leading West Coast research facility used the Memo-scope oscilloscope for passive satellite tracking. The instrument was able to integrate very small signal levels over a very high random noise level. Result: the company was able to track satellites in an environment where the noise amplitude actually exceeded the signal amplitude.

Quality Control Inspection—A large Eastern firm uses the Memo-scope oscilloscope to dramatically improve the reliability levels of incoming components and systems which were subject to transient behavior. Typical items tested included relays, switches, coils, capacitors, diodes, transistors, transformers, and complete computer and servo systems.

Shock and Impact Testing—A well-known missile manufacturer used the Memo-scope oscilloscope to calibrate accelerometers. Using a Model 105 Memo-scope oscilloscope, with a Multitracer Unit, this firm was able to compare a shock signal from a "calibrated standard" accelerometer against newly purchased units and those undergoing their periodic checks.

Medical Research—A large Texas medical institution used this unique Hughes instrument for a study of the human nervous system. They were able to obtain an early diagnosis of nervous system deterioration by measuring the exact elapsed time that an electrical pulse takes to pass between two points in the central nervous system.

Welding Control—To permit high-reliability welding of metals, a leading Southern California aircraft and missile manufacturer uses the Memo-scope oscilloscope as a precision monitoring device. They were able to precisely control heat, pressure and time throughout the entire welding process.



System Check-out: Production and Field—A well-known aircraft manufacturer used the Memo-scope oscilloscope as a key element in a check-out console. The communications and radar automatic gain controls, as well as the servo systems adjustments, were precisely monitored. It was also used in cross-talk analysis; interference monitoring; stress, vibration and flutter analysis; and general trouble-shooting.

SPECIFICATIONS

Conventional Mode:

- DC to 10 mc Band Pass
- Sweep Range: 0.1 μ secs/division to 1 sec/division; 5X Magnifier for speeds to .02 μ secs/division; Multiplier for sweeps long as 10 secs/division
- Rise Time: 35 nanoseconds
- Built-in Delay Line (0.25 μ secs)
- Numerous Trigger Selections
- Plug-in Preamplifiers

Storage Mode:

(All features of Conventional Mode, PLUS:)

- One million inches per sec Writing Speed
- Unlimited Storage Time
- Fast Erase (less than 150 millisecs)
- X-Y Plotting
- Single Shot Trigger
- Photograph or Trace Directly Off Scope Face

If you have a transient analysis problem and would like a complete technical data sheet, you are urged to write: Memo-scope Oscilloscope, Hughes Industrial Systems Division, Hughes Aircraft Company, Box 90904, Los Angeles 45, California.

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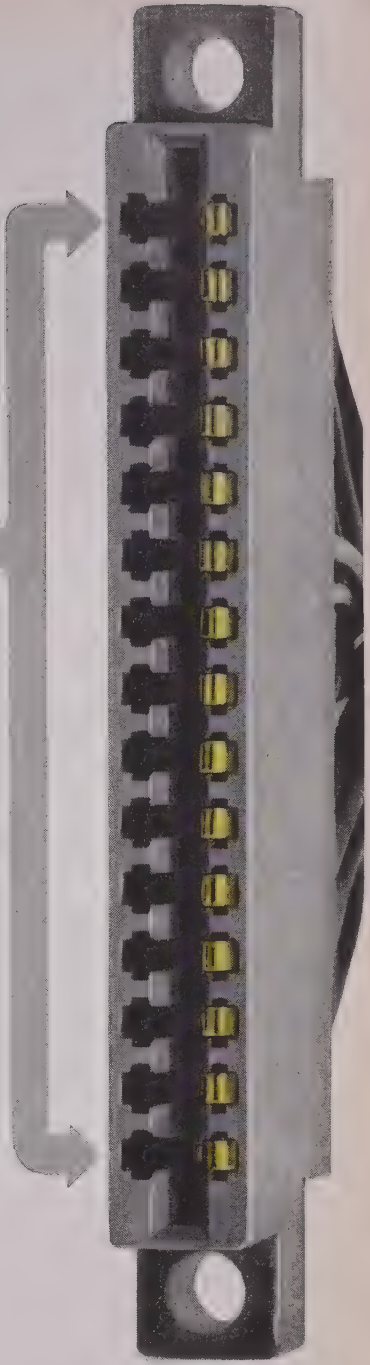
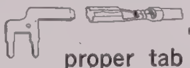
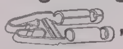
IF YOU DON'T USE 'EM . . . DON'T PAY FOR 'EM!



The **only** contacts you pay for in an AMPin-cert printed circuit edge connector are the ones you actually **use** for your specific circuitry, and here's why: AMPin-cert contacts are not fully pre-loaded into the housing. The unique AMP design, crimping wire directly to the contact, permits you to attach conductors to contacts **before** you load them. When you don't need two or three or six or seven of the available contact cavities, or a complete row of cavities in the case of one-sided boards, you don't load the contacts . . . and you don't pay for them!

So much for economics. What about contact versatility? The AMPin-cert line has five distinct types of contacts: Type I, AMP-leaf , a configuration which guarantees contact forces even on minimum-thickness boards. Type II, AMP-blade , a molded male tab housing to insure proper tab alignment, and a crimped type snap-in female receptacle offering three long, positive contact areas. Type III, DUO-Tyne , affords extremely high density, has four contact areas. Type IV, the right-angle AMP-flag DUO-Tyne , allows conductors to come out of connector at right angles, for easy cabling. Type V, AMP-taper in , ideal for quick jumpering, circuit change-over applications, accepts AMP taper pins.

Quality? AMPin-cert is quality, in the contacts and the housings:

- Contacts are phosphor bronze, gold over nickel plating
- Contacts accept single, multiple leads, and "snap-in" the housing without insertion tools
- Contacts are recessed in housing—no post insulation required
- AMPin-cert connectors will accept one-sided and two-sided boards

Ask us for the full AMPin-cert printed circuit connector story.

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WESCON SHOW
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AUGUST 22-25, 1961

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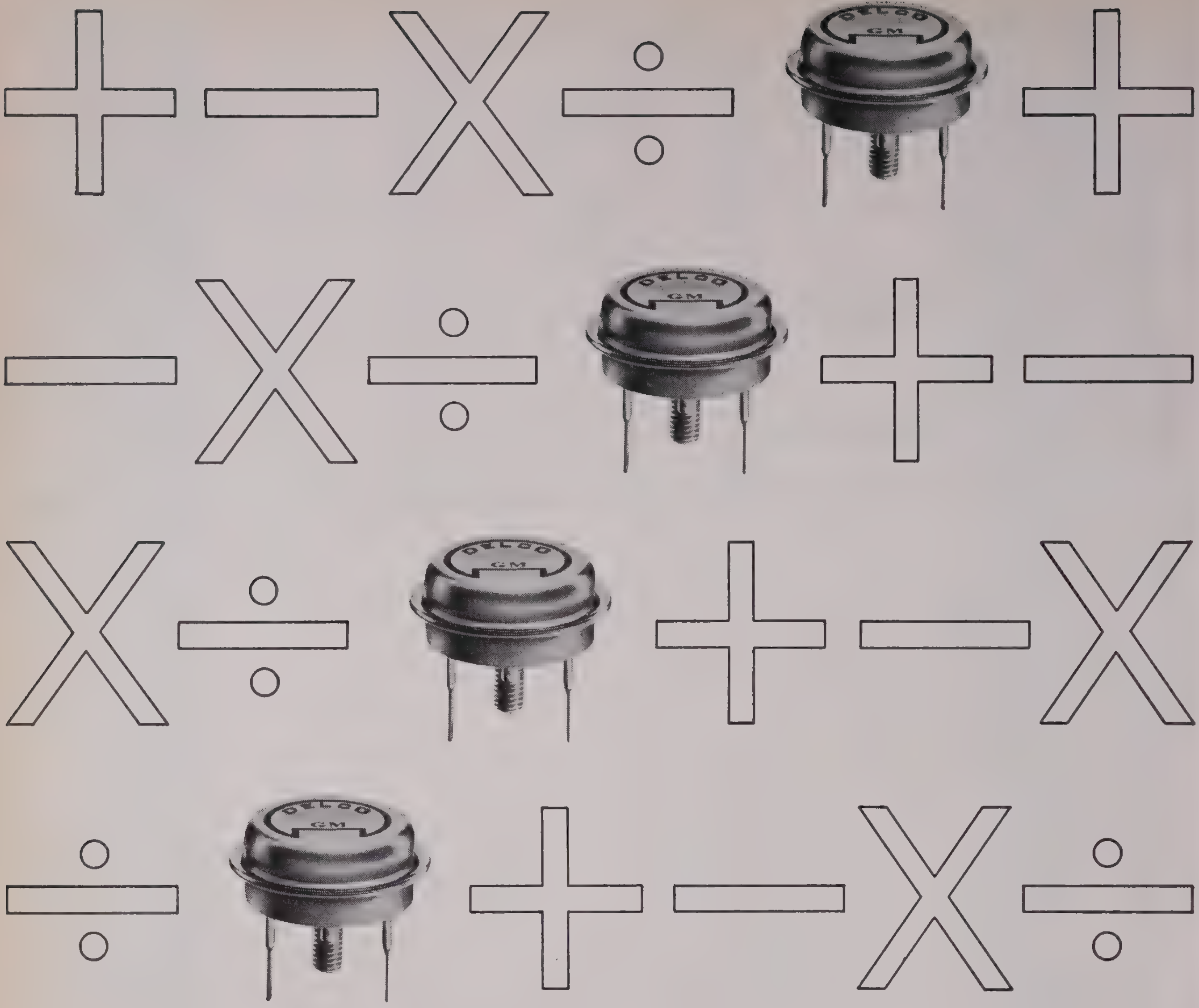

DELCO POWER TRANSISTORS PROVED IN COMPUTERS by IBM, UNIVAC,® BURROUGHS, NATIONAL CASH REGISTER

Since Delco Radio produced its first power transistors over five years ago, no transistors have undergone a more intensive testing program to assure reliability—which accounts for their popular acceptance in hundreds of industrial and military uses. Before leaving our laboratories, Delco transistors must pass numerous electrical and environmental tests both before and after aging. This double testing, combined with five years of manufacturing refinements, enables us to mass produce any type of power transistors with consistent uniformity. And we can supply them to you quickly in any quantity at a low price. For complete information or technical assistance on our versatile application-proved family of transistors, just write or call our nearest sales office or distributor.

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DELCO
DEPENDABILITY
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RELIABILITY

Division of
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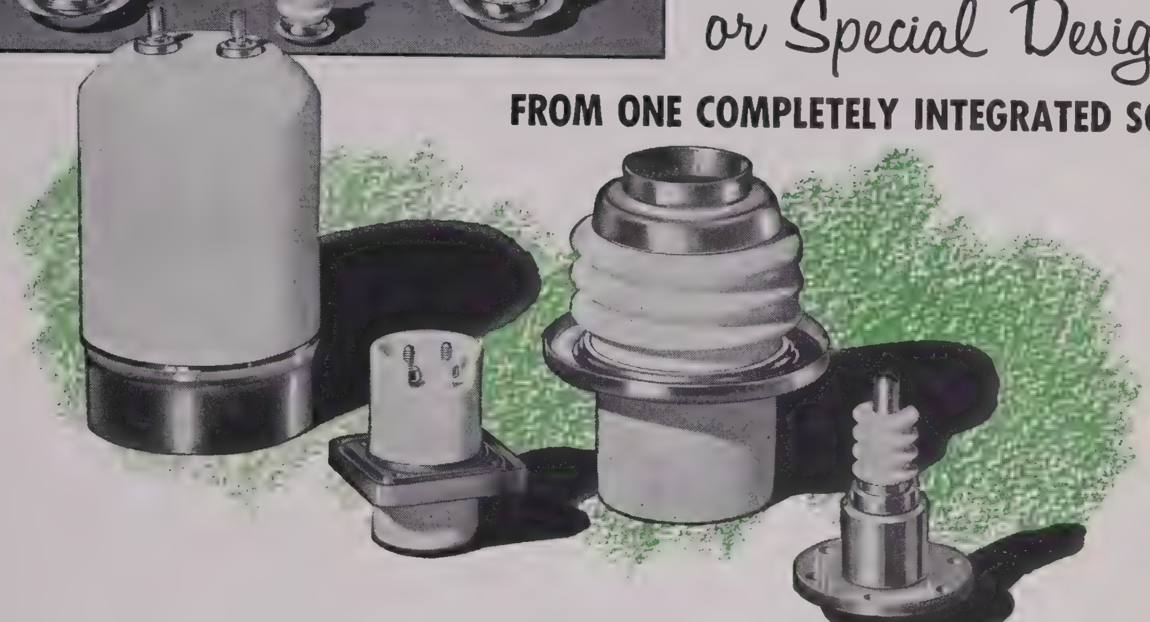
ALITE®

CERAMIC-TO-METAL SEALS

Standard Bushings or Special Designs

FROM ONE COMPLETELY INTEGRATED SOURCE



ALITE — with its completely equipped facilities for producing high quality, vacuum-tight, ceramic-to-metal seals — is geared to meet all your requirements for high alumina ceramic-metal components. From design to finished assembly, every manufacturing step — including formulating, firing, metalizing and testing—is carefully supervised in our own plant. Result: effective quality control and utmost reliability.

Hermetic seals and bushings made of high alumina Alite are recommended for electromechanical applications where service conditions are extremely severe or critical. Alite has high mechanical strength and thermal shock resistance. It maintains low-loss characteristics through a wide frequency and temperature range. It resists corrosion, abrasion and nuclear radiation. Its extra-smooth, hard, high-fired glaze assures high surface resistivity.

To simplify design problems and speed delivery, Alite high voltage terminals, feed-throughs and cable end seals are available in over 100 standard sizes. However, when specifications call for special units for unusual applications, you can rely on expert assistance from Alite engineers to help you take full advantage of Alite's superior properties.

Write us about your specific requirements today.

WRITE FOR HELPFUL FREE BULLETINS

Bulletin A-7R gives useful comparative data. Bulletin A-40 describes Alite facilities and complete line of Alite Standard Bushings.

ALITE DIVISION

U. S. STONEWARE

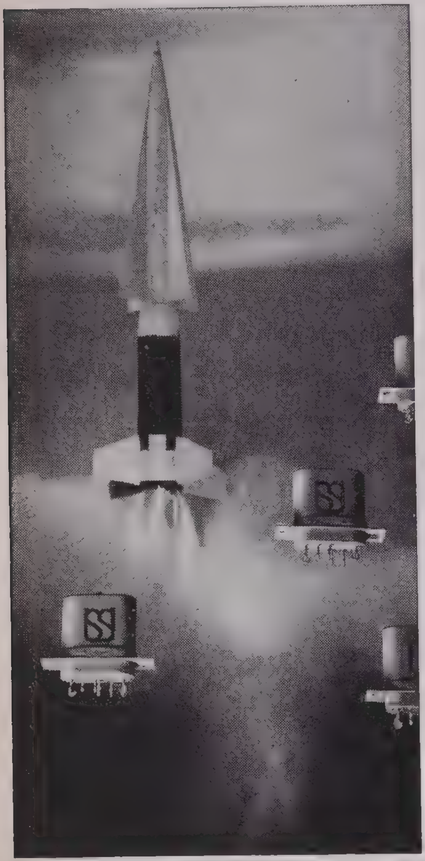
BOX 119 ORRVILLE, OHIO

102-G

Circle 32 on Inquiry Card

WESCON
VISIT US AT BOOTH No. 3101-03

RELAY NEWS from Union Switch & Signal



Contact Redundancy in New UNION Crystal Case Relays

The UNION 2-pole double throw General Purpose Crystal Case Relay is designed to consistently meet the requirements of Mil-R-5757D and Mil-R-5757/10. Its essential features . . . from minimum size to optimum reliability . . . permit it to be used in aircraft, guided missiles, shipboard and ground control electronic equipment.

A unique torsion-wire armature suspension system and a rugged all-welded frame construction provide a high level of vibration and shock immunity. Contact redundancy, which assures reliability in dry circuit and higher level contact loads, is provided through the use of bifurcated contacts.

Available with 0.2″ grid-spaced header or "S" type header, with various mountings, terminals, and operating voltages. Write for Bulletin 1064.

New 4-PDT-10-amp Relay Most Compact Rotary Type Available

This new durable relay is designed to meet the requirements of Mil-R-6106. It's a rugged relay featuring exceptionally sturdy terminals and husky contacts for high current applications. Glass-coated cylindrical contact actuators attached to the rotary armature provide square mating of contact surfaces, thereby assuring longer relay life. The balanced rotary armature provides maximum resistance to severe shock and vibration.

This small 4-PDT-10-Ampere relay is currently available with 115VAC and various DC operating voltages. Various mounting styles are provided. Write for bulletin 1069.

Why UNION Relays Are So Dependable

There's a good reason why our relays are the standard for reliability. For years, we've been building tough, reliable relays for use in airborne and guided missile electronic equipment and similar vital applications where perfect operation under severe environmental conditions is mandatory.

Our engineers created a compact 6-PDT miniature relay with just three major assemblies . . . instead of a fistful of small parts. This was accomplished by using a balanced rotary-type armature that provided a maximum resistance to the severe shock and vibration environment of aircraft and guided missiles. The rotary principle of operation is utilized in all our relays.

We have a reputation for building reliable electronic components and we intend to maintain our tradition for building reliable relays. And we supply these quality relays in quantity. Stocks are now available for prototype requirements in New York, Pittsburgh, Dallas and Los Angeles.

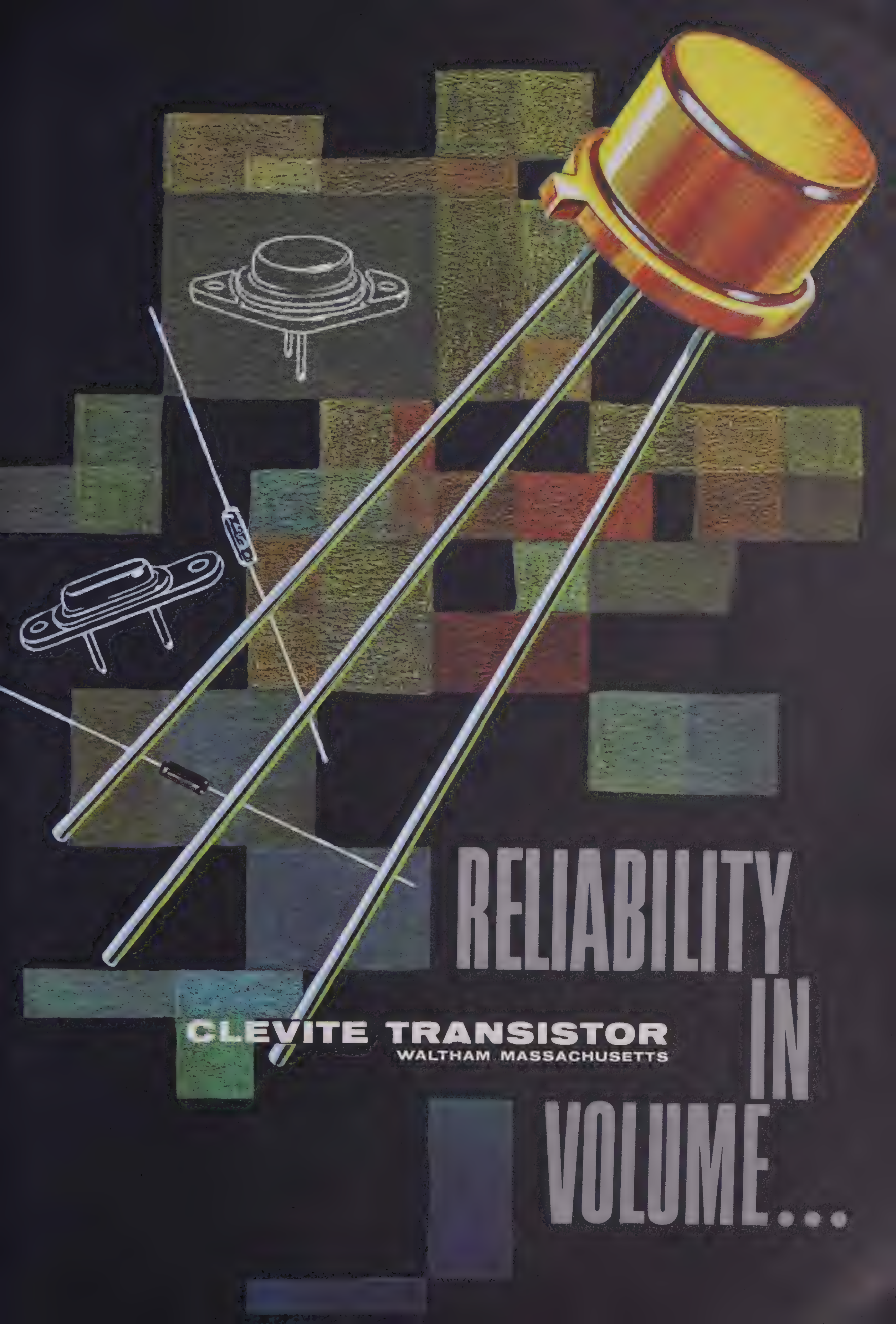
For additional information, write for Bulletin 1017 or call Churchill 2-5000 in Pittsburgh.

MEMBER OF THE NATIONAL ASSOCIATION OF RELAY MANUFACTURERS

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY —
PITTSBURGH 18, PENNSYLVANIA

Circle 33 on Inquiry Card

Circle 34 on Inquiry Card →


RELIABILITY
IN
VOLUME...
CLEVITE TRANSISTOR
WALTHAM MASSACHUSETTS

Factors to consider in silicon diode selection

by **DAVID E. HUMEZ**

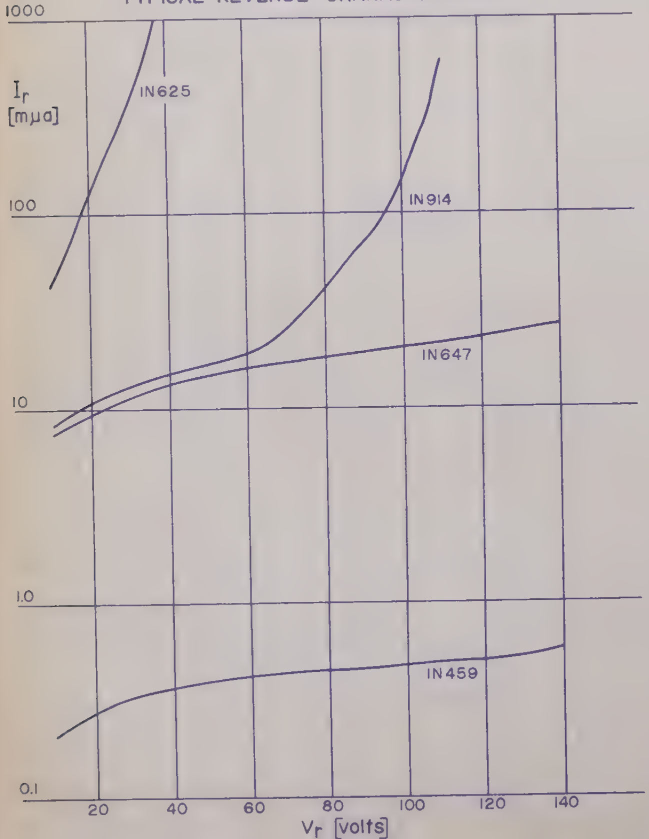
Technical Advisor to the Manager of Operations
Clevite Transistor, Waltham, Mass.

If your circuit does not require the superior forward conductivity characteristics of germanium diodes or if you require extremely low reverse currents or must operate at temperatures above 50°C, you will probably select a silicon diode.

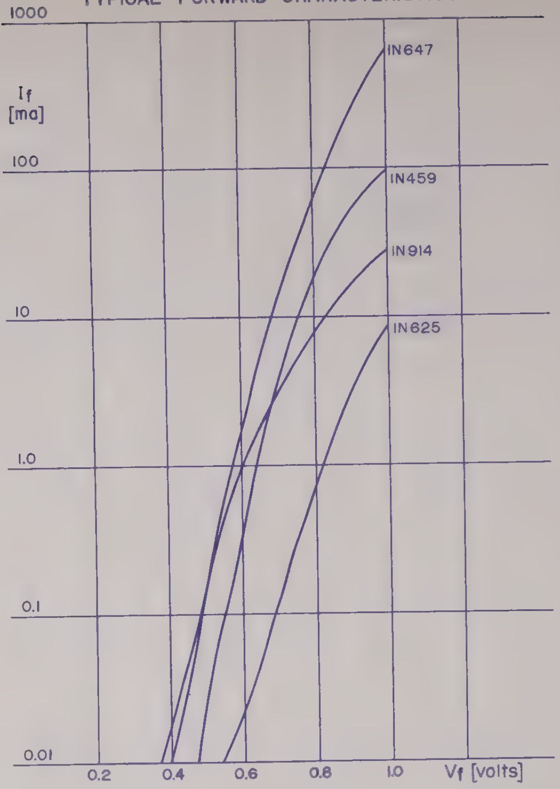
Of the bewildering array of silicon diode types available some will almost certainly suit your circuit better than others. Current silicon diode types fall into four main categories with many sub-categories. The first category historically was the general purpose alloy junction silicon diode. These diodes are principally useful in those applications in which good high voltage characteristics, very low leakage currents, even at high temperatures, are necessary. They are available with comparatively high forward conduction and over a wide range of voltages up to several hundred volts.

The next category is that of computing application silicon diodes. These differ from the general purpose diodes in that the material from which they are made is doped or otherwise treated in such a way as to reduce its bulk lifetime. Reduction of the lifetime of the material makes possible much faster operation, that is, faster recovery when switched from the forward to the reverse condition. Such diodes have found wide application in military and commercial computing circuitry which is expected to operate at high temperatures. A price is paid, however, for higher speed since reducing the lifetime of the material results also in an increase of the reverse current and a decrease in the forward conduction.

TYPICAL REVERSE CHARACTERISTICS



TYPICAL FORWARD CHARACTERISTICS



The third and fourth groups are the most recent and employ a different method, namely, solid state diffusion for producing the PN junction. The third group, sometimes called rectifiers, are devices fabricated in either the same subminiature glass package familiar in other diode types or this glass package modified by the inclusion of a larger diameter stud at one electrode for improved heat conduction. They are large area devices compared to the diodes in categories one and two and are designed for conduction of as much as 400 milliamperes at a volt. Since their area is substantially larger, their capacitance is also larger though not as large as would be expected by the ratio of areas, since the method of producing the junction results in less capacitance per unit area than is characteristic of alloyed junctions.

SWITCHING SPEED —— REVERSE RECOVERY

Units switched by mercury wetted chopper from 15 ma forward current to 1.2 volts reverse in series with a 100 ohm load resistor. Recovery to 1 ma.

Unit	Time mμsec.	Types
1N914	2.5	silicon mesa diode.
1N625	60.	high speed silicon alloy diode.
1N459	1500.	general purpose silicon diode.
1N647	8000.	silicon diffused rectifier.

The fourth and newest category is that of extremely small area devices made by the newer techniques of the mesa or planar constructions. These types are also manufactured by a diffusion process. They are designed primarily for applications in which the very fastest switching speeds are required. For this additional speed, compared to conventional computing alloyed junction types, a further price must also be paid. Because they are tiny, they are also less rugged. Because their area is smaller, both the resistance of the connecting wires and the spreading resistance are larger. Consequently, these devices as a group are characterized by somewhat poorer forward conduction than is true of the larger area computing diodes.

Ask for Silicon Diode Bulletins

CLEVITE TRANSISTOR
Waltham, Massachusetts

Letters to the Editor

"Aeronautical" to "Aerospace"

Editor, ELECTRONIC INDUSTRIES:

I enjoy reading ELECTRONIC INDUSTRIES and find that it is a useful publication. Your March 1961 cover is indeed unique. However, I am a member of one of the societies whose former insignia is shown on this cover and feel that I should inform you that in September 1960 the official title of the Institute of Aeronautical Sciences was changed to the Institute of Aerospace Sciences in accordance with the expanded range of this society for the last four or five years.

H. C. Rechtien, Jr.
Recording Secretary
St. Louis Section, IAS
Box 516
St. Louis, Mo.

Teletype Bulletin Alarm

Editor, ELECTRONIC INDUSTRIES:

This is in regard to the correspondence in your "Letters to the Editor" column regarding the teletype bulletin alarm.

Enclosed is a copy of an article I wrote for "Communications" Magazine in 1949 describing a similar system.

I have no desire to engage in a controversy about who was first because this gadget is typical of solutions to problems which a number of broadcast engineers often arrive at independently of each other.

Yours truly,
George W. Ing
Director of Engineering
KONO AM-TV, KITY (FM)
Mission Broadcasting Co.
317 Arden Grove, Box 2338
San Antonio 6, Texas

"Minuteman" Reliability

Editor, ELECTRONIC INDUSTRIES:

We noted your article regarding reliability and the special (December, 1960) issue covering the Minuteman program. We were pleasantly surprised to see the similarity between this reliability program and our own reliability program. Our program was initiated and planned independently and naturally we take pride in this program. We believe that we are the only custom motor manufacturer who instituted such a program today and are enclosing a copy of our brochure for your interest.

Yale J. Holt
Sales Manager
Globe Industries Inc.
1784 Stanley Ave.
Dayton 4, Ohio

(Continued on page 54)

Resistance Values up to 100,000,000 Megohms

Model RX-1 Hi-Meg Resistor

Victoreen Hi-Meg Resistors — Standard of the Industry for Over 18 Years

Available tolerances
1% 2% 5% 10%

■ For longer life, Victoreen Hi-Meg Resistors are in a class by themselves, especially for all high-impedance, low-current applications. Hi-Meg Resistors have a carbon-coated glass rod element with silver-banded ends for best electrical contact . . . are vacuum sealed in a glass envelope treated with special silicone varnish that minimizes moisture effects. Always specify Victoreen Hi-Meg Resistors for the ultimate in long-term stability.

Victoreen

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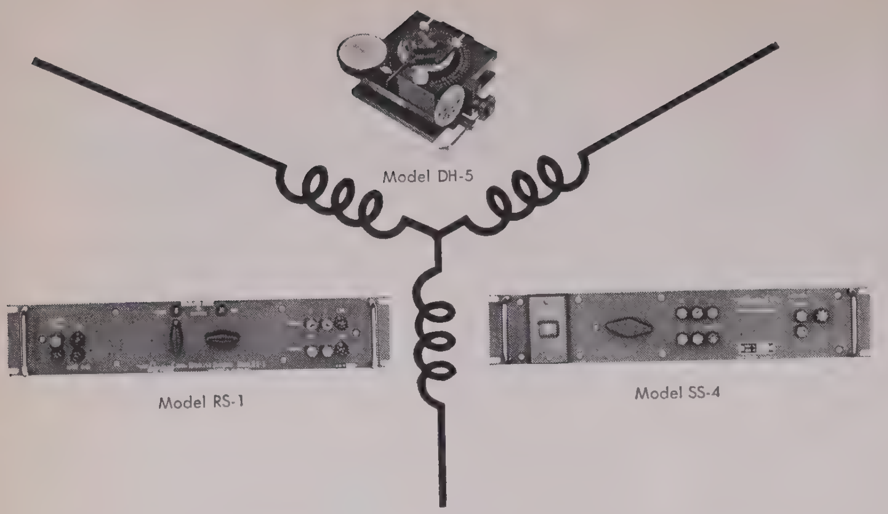

now...high accuracy synchro and resolver testing

— GERTSCH STANDARDS REPLACE COSTLY ELECTRO-MECHANICAL METHODS

Gertsch Synchro Standards simulate the output of a master Synchro Transmitter (CX), with better than 2 seconds of arc accuracy. Ideal for checking Synchro Control Transformers (CTs), or complete systems. Units feature a low effective unbalance impedance which permits loading the output without introducing stator output errors.

When driven by a suitable signal source, unit provides stator outputs S_1, S_2 and S_3, corresponding to the outputs of a master Synchro Transmitter as the shaft is rotated in 5° increments. Quadrant switching simulates operation over a full 360°. Series SS.

Gertsch Resolver Standards simulate the output of a master Resolver Transmitter (RX). Checks Resolver Control Transformer (RCT). Unit features low effective unbalance impedance, hence negligible loading error.

Driven by a suitable signal source, unit produces 2 isolated output voltages corresponding to the sine and cosine output voltages of a master Resolver Transmitter as the shaft is rotated in 5° increments. Full 360° operation. Series RS.

Synchro and Resolver Standards rotate throughout a full 360°, in 5° increments. Accuracy is better than 2 seconds of arc. Both single-switch and 2-switch models are available to cover all standard voltages and frequencies. Bulletins SS and RS on request.

Gertsch Divider Heads—for checking angular measurements on all types of rotary components. Accuracy is ±15 seconds. Repeatability: ±5 seconds. Large dial indicator provides direct readings with 3-second resolution. Unit rotates in 5° steps through a full 360° in either direction . . . is quickly set up, easy to operate, and fully portable. Bulletin DH-5.

Gertsch

GERTSCH PRODUCTS, Inc.,

3211 South La Cienega Boulevard, Los Angeles 16, California / UPton 0-2761 — VErmont 9-2201

Circle 40 on Inquiry Card

Letters to the Editor

(*Continued from page* 53)

"Analyzing A Realistic Cathode Follower"

Editor, ELECTRONIC INDUSTRIES:

It was a pleasure to read Raymond Lafferty's article on "Analyzing a Realistic Cathode Follower" in your May 1961 issue.

Our school has been requiring students to perform, as one of a series of weekly laboratory assignments a very similar analysis. Then to design and construct the circuit to required performance specifications.

One disagreement with the article. That is, the input impedance of a cathode follower with a tapped cathode resistor begins to degenerate at a relatively low frequency. This is true since the impedance of the input capacitance approaches that of the augmented input resistance sooner. In fact, the input impedance begins to be noticeably affected by interelectrode capacitances in a typical circuit at about 10 kc. Conversely, the output circuit with its low Z_o does not begin to degenerate until a much higher frequency is reached.

Incidentally, our school is fairly unique in the Navy since we provide for selected limited duty and warrant officers about two and a half years of college level electronics engineering training in 52 weeks.

Richard V. Hartman
LCDR USN

Electronics Technical Officers School
Naval Air Technical Training Center
Building S-104
Memphis 56, Tennessee

Mr. Lafferty answers

Editor, ELECTRONIC INDUSTRIES:

When Mr. Hartman speaks of the input impedance of the cathode follower in question degenerating at frequencies as low as 10 kc, he is correct, providing the circuit parameters have been selected to yield an input impedance of, say 15 to 20 megohms, at lower frequencies. His statement should not be misconstrued, however, to imply that the circuit is limited to use at low frequencies. This particular circuit is actually used up to, and exceeding 100 MC. The circuit parameters, of course, must be selected for this, and the source impedance must be low. However, if the source is low (usual case), even the cathode follower with a high input impedance will not show any degradation at frequencies below several hundred kilocycles.

What is not clear in Mr. Hartman's letter, is his disagreement. Perhaps we can assume he overlooked the

(*Continued on page* 58)

Circle 38 on Inquiry Card →

U CAN SPECIFY savings in weight, improve-
nts in performance, increases in reliability for
r electronic systems from this box. This is
rry's Speci-File—a complete electronic and phys-
biography of the traveling wave and klystron
es offered by Sperry Gainesville. To speed your
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benefits of outstanding microwave tube perform-
e for your systems, order your free Sperry Speci-
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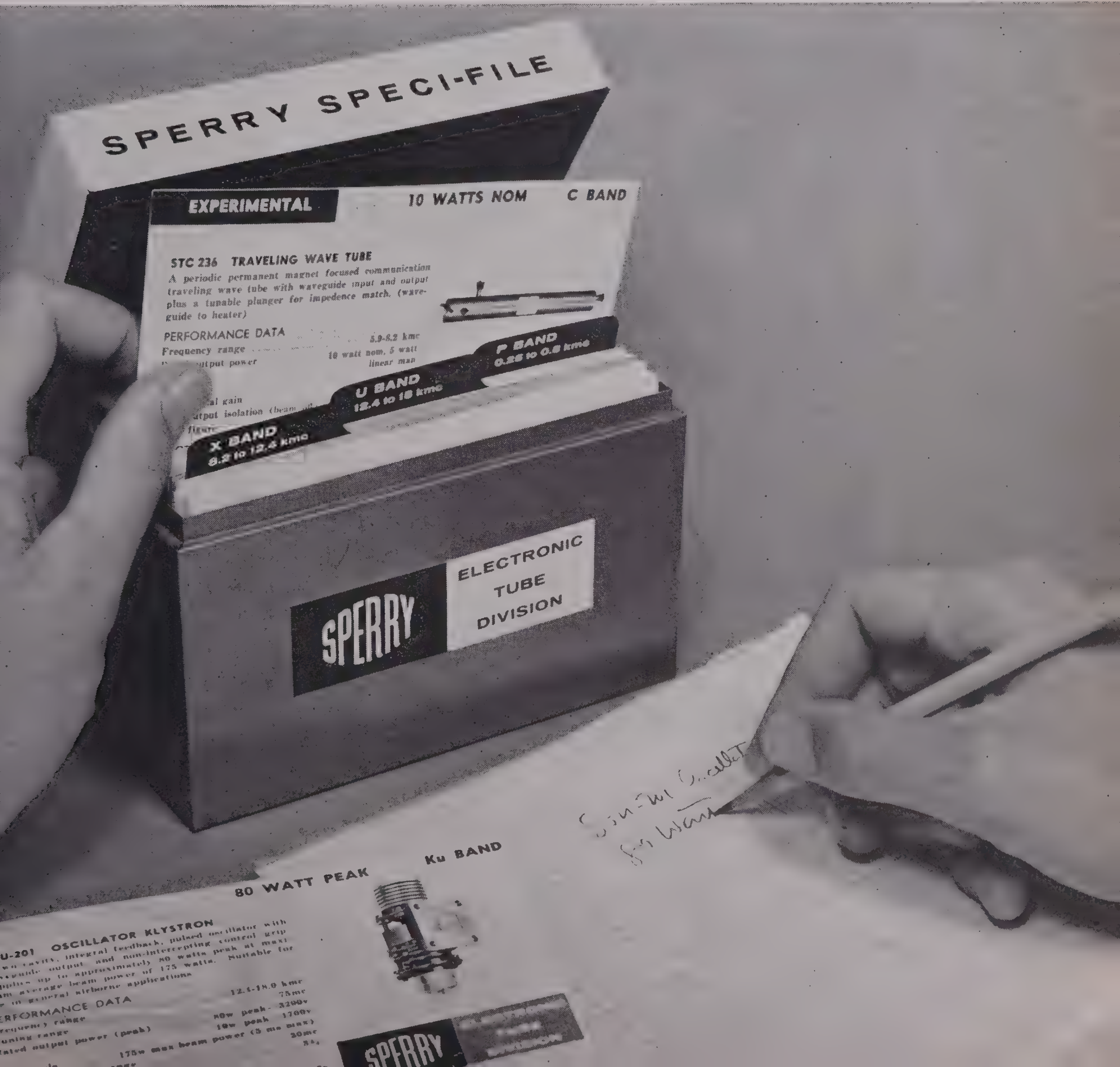
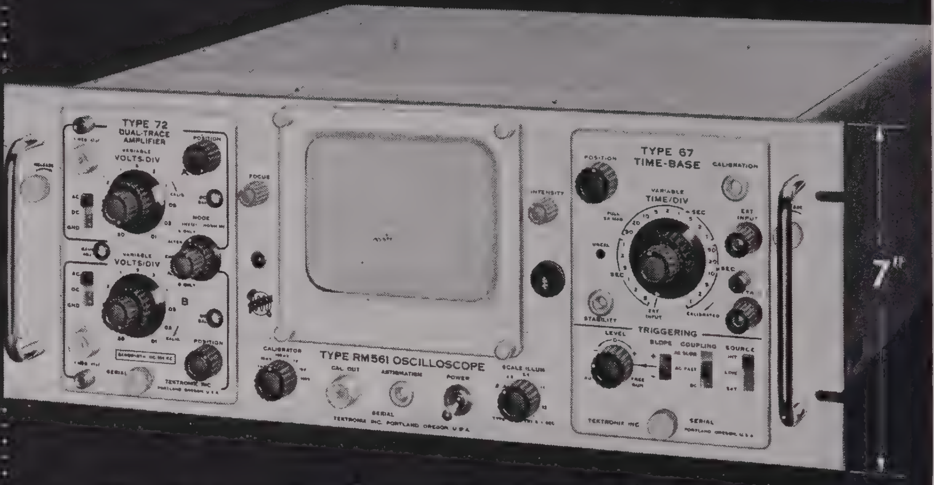

SPERRY SPECI-FILE
EXPERIMENTAL
10 WATTS NOM
C BAND
STC 236 TRAVELING WAVE TUBE
A periodic permanent magnet focused communication traveling wave tube with waveguide input and output plus a tunable plunger for impedence match. (waveguide to heater)
PERFORMANCE DATA
P BAND 0.25 to 0.5 kmc
U BAND 12.4 to 18 kmc
X BAND 8.2 to 12.4 kmc
SPERRY ELECTRONIC TUBE DIVISION
80 WATT PEAK
Ku BAND
OSCILLATOR KLYSTRON
PERFORMANCE DATA

Now! . . . *in a low-cost Tektronix Oscilloscope . . .*

you choose the type and degree of performance you demand for a particular rack-mount application.

Type RM561 Oscilloscope

with 5-inch CRT —basically an Indicator which accepts a wide range of plug-in units in both channels.



easily interchangeable PLUG-IN UNITS

. . . which drive the crt deflection plates directly.
. . . which house approximately ⅔ of the circuitry.
. . . which contain minimum components and controls.

The Type RM561 bolts directly to a standard nineteen-inch rack, and *requires only seven inches of rack height.* Optional slideout tracks can be ordered separately—with or without tilt locks.

TYPE RM 561 INDICATOR $450

5-inch rectangular cathode-ray tube • 3.5 kilovolts accelerating potential • 8 by 10 centimeter viewing area • Z-axis input • 6 calibrated square-wave voltages available—ranging from 1 millivolt to 100 volts • Regulated dc heater voltage thru separate regulator circuitry.

Regulated dc supply operates between 105 to 125 volts or 210 to 250 volts, 50 to 60 cycles . . . *provides 85 watts for powering all present and future plug-in units in this series.*

See this Tektronix Oscilloscope at WESCON—Booths 1726-1728, 1823.

AVAILABLE NOW Plug-in units presently available include:

Type 50 Vertical Amplifier **$115**
Passband—15 cps to 200 kc.
Sensitivity—1 mv/cm.

Type 51 Time-Base Unit **$135**
Sweep rate—5 ms/cm, calibrated.
Magnifier—Variable, uncalibrated, from 1X to 20X.
Triggering—Automatic or free-run.

Type 59 Basic Amplifier **$50**
Passband—dc to 400 kc, at maximum sensitivity.
Sensitivity—approximately 1 v/cm, attenuation provided by variable potentiometer at the input.
Maximum Input Voltage—600 volts.

Type 60 1-MC Amplifier **$99.50**
Passband—dc to 1 mc.
Sensitivity—50 mv/cm to 50 v/cm, calibrated decade-step attenuator (4 steps), with variable control.

Type 63 Differential Unit **$125**
Differential input, 50-to-1 rejection ratio at maximum sensitivity.
Passband—dc to 300 kc.
Sensitivity—1 mv/cm to 20 v/cm in 14 calibrated steps, with variable control.

Type 67 Time-Base Unit **$150**
Sweep rates—21 calibrated steps from 1 μsec/cm to 5 sec/cm, accurate within 3%.
Magnifier—5X.
Triggering—Amplitude-level selection, automatic, or free-run, ac-coupled or dc-coupled, rising or falling slope, internal source, external source, or line frequency.
External Input to Sweep Amplifier—1 v/cm sensitivity.

Type 72 Dual-Trace Unit **$250**
Identical Channels—5 operating modes: alternate sweeps, chopped, Channel A only (may be inverted), Channel B only, both channels combined at output (B ± A).
Passband—dc to 650 kc.
Sensitivity—10 mv/cm to 20 v/cm in 11 calibrated steps, with variable control.

Type 75 Wide-Band Unit **$175**
Passband—dc to 4 mc.
Sensitivity—50 mv/cm to 20 v/cm in 9 calibrated steps, with variable control.
Risetime—approximately 85 nanoseconds.

Skeleton Plug-In Unit Contains 24-pin connector, latch, front-panel overlay . . . for constructing your own circuits. **$15**

Prices F.O.B. Factory

AVAILABLE SOON Plug-in units under development include those for pulse-sampling, four-trace work, high-gain measurements, strain gage and other transducer applications.

For a demonstration, please call your Tektronix Field Engineer.

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TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics: Portland, Oregon; Seattle, Washington • Kentron Hawaii Ltd., Honolulu, Hawaii. Tektronix is represented in twenty overseas countries by qualified engineering organizations.

In Europe please contact Tektronix International A.G., Terrassenweg 1A, Zug, Switzerland, Phone (042) 4-91-92, for the address of the Tektronix Representative in your country.

"Right! You're sure of reliability with DALE Type WW or HW Resistors"

In planning any circuit, even the most advanced, you can check off one question mark the minute you specify Dale precision resistors.

Resistor reliability in that circuit is assured, under any and all conditions, because of Dale's advanced design and methods of manufacture . . . methods which have reached new levels of achievement as part of Dale's super-high reliability development program.

SPECIAL PROBLEMS? Let us help you with your requirements for special resistance products. We make modifications of standard products, resistor networks, matched pairs, etc. Send us your specs.

PROMPT DELIVERY: Whether your need is for a short "test run" or a large production release, Dale offers prompt service, direct from the factory and through a widespread network of distributors.

Write for Bulletin R-26 with handy cross reference file card

Hathaway Instruments Inc.

DALE ELECTRONICS, INC.
1304 28th Ave., Columbus, Nebraska, U.S.A.

A subsidiary of HATHAWAY INSTRUMENTS, INC.

DALE TYPE WW & HW RESISTORS

WIRE WOUND • BOBBIN • ENCAPSULATED

Dale bobbin type resistors are impervious to salt spray, humidity, moisture and corrosive gases and vapors. The encapsulating material has very high di-electric strength. The resistors have excellent non-inductive characteristics. They are made to surpass functional requirements of MIL-R-93B. (Some sizes and ranges not included in Mil Specs.) WW prefix meets requirements of characteristic A; HW prefix meets requirements of characteristic C.

- RESISTANCE RANGE: 0.1 ohm to 6 megohms, depending on size.
- TOLERANCE: ±.02%; ±.05%; ±0.1%; ±0.25%; ±0.5%; ±1%; ±3%.
- RATED AT: 0.1 watt to 2.5 watts, depending on size, type and tolerance.
- TEMPERATURE COEFFICIENT: 0.00002 per degree C.
- TERMINALS: WWA and HWA — axial leads; WWP and HWP — parallel leads; WWR and HWR — radial leads; WWL and HWL—lugs.
- SIZES: Complete range from sub-miniature 5/64"x5/16" to 1/2"x2".

Circle 98 on Inquiry Card

See the New...

(ADC) BLUE CHIP

TRANSISTOR TRANSFORMERS

At WESCON booth #4218

Wide Choice of Power Ratings

Tiny plastic encapsulated ADC transformers are now available for printed circuit applications in a wide choice of power ratings. Five sizes vary from .08 to 1.2 cubic inches.

Sixty-Four New Types

Sixty-four new ratings listed below show the available power levels for voice and extended frequency operation. They take into account not only power handling capacities at minimum frequencies but also total harmonic distortion under stated conditions. Variations in both power and distortion levels are possible, within the limits shown, depending upon the minimum operating frequency.

Designed to meet MIL Specs.

These new transformers were designed to meet MIL-T-27A Grade 5, Class S requirements.

Order from stock after September 1st

PIN LAYOUT:

Pin Diameter: .020"
Pin Length: ¾"
Weight: 0.15 oz.

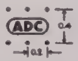
RESPONSE: ± 3 DB 60 to 100,000 CPS.
DISTORTION: 10% at 1 MW, 60 to 100,000 CPS, or 10% at 30 MW, 300 to 100,000 CPS, except as noted.

PIN LAYOUT:

Pin Diameter: .030"
Pin Length: ½"
Weight: 0.4 oz.

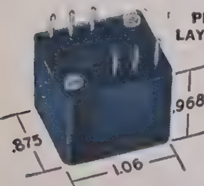
RESPONSE: ± 1 DB 60 to 50,000 CPS.
DISTORTION: 10% at 10MW, 60 to 50,000 CPS, or 10% at 150 MW, 200 to 50,000 CPS.

PIN LAYOUT:



Pin Diameter: .030"
Pin Length: ½"
Weight: 0.9 oz.

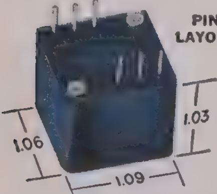
RESPONSE: ± 1 DB 60 to 30,000 CPS.
DISTORTION: 1.5% at 20 MW, 60 to 30,000 CPS, or 10% at 500 MW, 200 to 30,000 CPS, except as noted.



PIN LAYOUT:

Pin Diameter: .040"
Pin Length: ½"
Weight: 1.5 oz.
Mounting: 2—4x40 Inserts, 0.6"x0.8"

RESPONSE: ± 1 DB 50 to 10,000 CPS.
DISTORTION: 1.5% at 60 MW, 60 to 10,000 CPS, or 10% at 3.5 W, 200 to 10,000 CPS, except as noted.



PIN LAYOUT:

Pin Diameter: .040"
Pin Length: ½"
Weight: 2.5 oz.
Mounting: 2—4x40 Inserts, 0.8"x0.8"

RESPONSE: ± 1 DB 30 to 10,000 CPS.
DISTORTION: 1% at 250 MW, 60 to 10,000 CPS, or 10% at 10 W, 200 to 10,000 CPS, except as noted.

CATALOG NUMBER	PRIMARY IMPED.—OHMS	SECONDARY IMPED.—OHMS	PRIMARY-SECONDARY DC RESISTANCE-OHMS		MAX. DC IN PRIM. MA.
324–6A	★ 100K–CT	1000–CT	3000	70	0
324–6B	25K–CT	1000–CT	2800	120	0
124–6C	10K–CT	10K–CT	1100	1200	1
324–6D	10K–CT	1500–CT	1100	180	1
324–6E	10K–CT	600–CT	1100	75	1
224–6F	4000–CT	10K–CT	440	1200	1.5
324–6G	1000–CT	600–CT	110	75	3
324–6H	1000–CT	4	110	0.5	3
224–6J	600–CT	25K–CT	65	3000	4
124–6K	600–CT	600–CT	65	75	4
324–6L	600–CT	60	65	7	4
324–6M	600–CT	4	65	0.5	4
★Max. power level: 0.35 mw at 60 cps; 10 mw at 300 cps.					
324–5A	100K–CT	1000–CT	11,000	120	0
324–5B	25K–CT	1000–CT	2800	120	0
124–5C	10K–CT	10K–CT	1100	1200	1
324–5D	10K–CT	1500–CT	1100	180	1
324–5E	10K–CT	600–CT	1100	75	1
224–5F	4000–CT	10K–CT	440	1200	1.5
324–5G	1000–CT	600–CT	110	75	3
324–5H	1000–CT	4	110	0.5	3
224–5J	600–CT	25K–CT	65	3000	4
124–5K	600–CT	600–CT	65	75	4
324–5L	600–CT	60	65	7	4
324–5M	600–CT	4	65	0.5	4
324–4A	★ 100K–CT	1000–CT	11,000	120	0
324–4B	25K–CT	1000–CT	2800	120	0
124–4C	10K–CT	10K–CT	1100	1200	1
324–4D	10K–CT	1500–CT	1100	180	1
324–4E	10K–CT	600–CT	1100	75	1
324–4F	10K–CT	4	1100	0.5	1
224–4G	4000–CT	10K–CT	440	1200	1.5
324–4H	1500–CT	15	165	2	2.5
324–4J	1000–CT	600–CT	110	75	3
324–4K	1000–CT	4	110	0.5	3
224–4L	600–CT	25K–CT	65	3000	4
124–4M	600–CT	600–CT	65	75	4
324–4N	600–CT	60	65	7	4
324–4P	600–CT	15	65	2	4
324–4Q	600–CT	4	65	0.5	4
224–4R	250	600–CT	30	75	7
★Max. power level: 150 mw.					
324–3A	10K–CT	10K–CT	800	1100	1
324–3B	10K–CT	600–CT	800	65	1
324–3C	10K–CT	4	800	0.5	1
324–3D	1500–CT	15	120	2	2.5
324–3E	1000–CT	600–CT	80	65	3
324–3F	1000–CT	4	80	0.5	3
224–3G	★ 600–CT	25K–CT	50	2800	4
124–3H	600–CT	600–CT	50	65	4
324–3J	600–CT	60	50	7	4
324–3K	600–CT	15	50	2	4
324–3L	600–CT	4	50	0.5	4
224–3M	250	600–CT	20	65	7
★Max. power level: 2.5 w.					
124–2A	★ 10K–CT	10K–CT	700	900	1
324–2B	★ 10K–CT	600–CT	700	55	1
324–2C	★ 10K–CT	4	700	0.5	1
324–2D	1500–CT	15	105	1.5	2.5
324–2E	1000–CT	600–CT	70	55	3
324–2F	1000–CT	4	70	0.5	3
224–2G	★★ 600–CT	25K–CT	45	2400	4
124–2H	600–CT	600–CT	45	55	4
324–2J	600–CT	60	45	6	4
324–2K	600–CT	15	45	1.5	4
324–2L	600–CT	4	45	0.5	4
224–2M	250	600–CT	20	55	7

★Max. power level: 6 w. ★★Max. power level: 2.5 w.

ALL RATINGS BASED UPON MAXIMUM UNBALANCED DC IN PRIMARY AS LISTED

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Circle 36 on Inquiry Card

Letters to the Editor

(Continued from page 54)

next to last paragraph in which it was stressed that the analysis held only for small signal, low frequency operation, and the equivalent circuit presented would be altered by tube and stray capacitance at high frequencies.

Raymond E. Lafferty
Chief Engineer

Boonton Electronics Corporation
738 Speedwell Avenue
Morris Plains, New Jersey, U. S. A.

The "Law of Ohm"

Editor, ELECTRONIC INDUSTRIES:

I have belatedly read with much interest the speech by Mr. David Packard at WESCON in your September 1960 issue and also the comments by Mr. O. A. Meykar in Letters to the Editor in your November 1960 issue.

However I am considerably puzzled by the conclusion that Ohm's Law is not known by that name in the Soviet Union. To introduce some factual information on this matter I submit a copy of page 132 from "Electricity," the second volume of "A General Course of Physics" by C. G. Kalashnikov (title page enclosed), which I presume is a standard textbook in Russia.

The title of Section 66 on page 132 clearly says OHM'S LAW (actually "Law of Ohm"—the final letter "a" on OM [OHM] signifying the genitive case). Incidentally, on the bottom line in italics is the expression "volt-ampere characteristic." Their terms seem to parallel ours quite closely.

I suspect that all of this confusion is due to an interpreter's misunderstanding and is a further illustration of the seriousness of language barriers.

Roger E. Schell

Radio Corp. of America
Camden, New Jersey

RFI Series

Editor, ELECTRONIC INDUSTRIES:

I find that I have not received a copy of the article "Transmission Lines (& Filters)," by D. C. Ports of Jansky & Bailey.

In trying to make up my folder of the articles on RFI for ready reference I found that this is the only article that is missing.

You are to be commended on the excellent presentation of this series of articles. May we have more of them.

Kirke G. Schnoor

Melpar, Inc.
Falls Church, Va.

hp

Easier reading continuous display
Higher sampling rate
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Wide temperature range
Low-frequency accuracy
Versatile new modular design
Measurement flexibility, moderate cost

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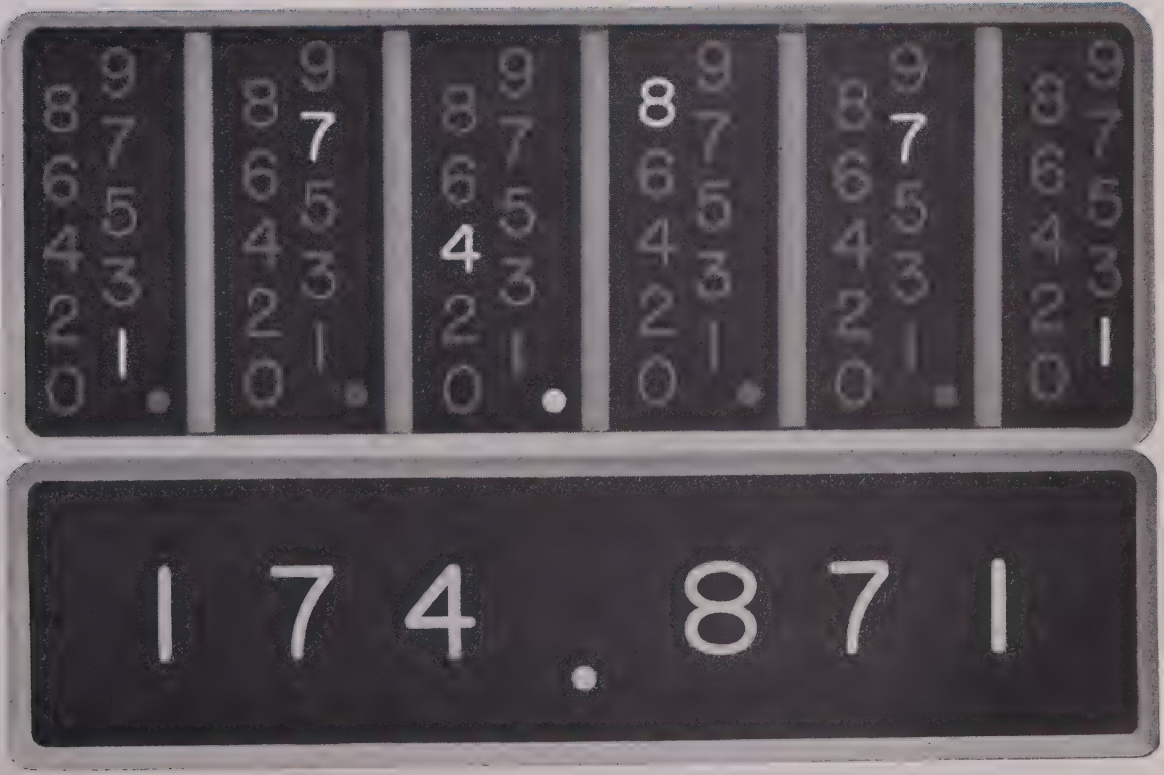
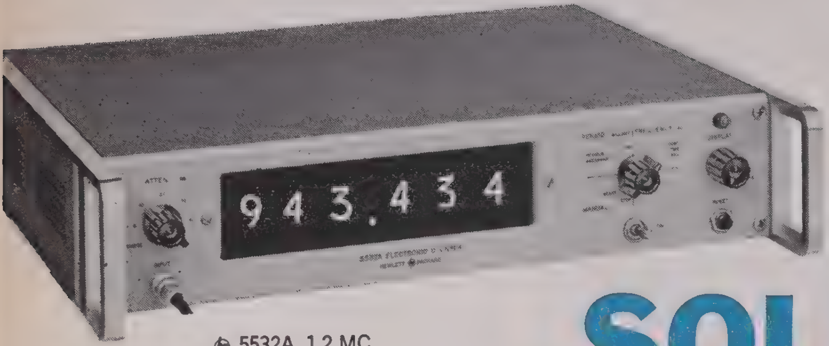


Turn the page to learn about new measuring convenience, dependability from hp.

a pleasure
to measure
with these...

hp 5512A, 300 KC


hp 5532A, 1.2 MC

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Measure frequency, period, ratio, quickly, accuratel continuous display, no "blinking"...0.1 volt sensitivit ...Unique low frequency accuracy...Operation –20° t

All the advantages of solid-state design are now yours in these new hp solid state counters—offered at prices comparable to those of today's vacuum tube counters. And you get the *plus* advantages of greater readability, faster measurements, easier routine maintenance, rack-and-stack convenience of the new hp universal module instrument cabinets.

Offered in four models, these new counters have maximum counting rates of 300 KC or 1.2 MC, with a choice of Nixie or columnar readouts. The high-intensity neon readouts are stacked in compact columns for faster, easier reading. On the in-line readouts, hp-pioneered standard incorporation of the new long-life, wide-viewing Nixies gives you many extra hours of lamp life and heretofore unknown readability even at extreme angles. Polarized screen provides maximum readout brilliance with freedom from reflections.

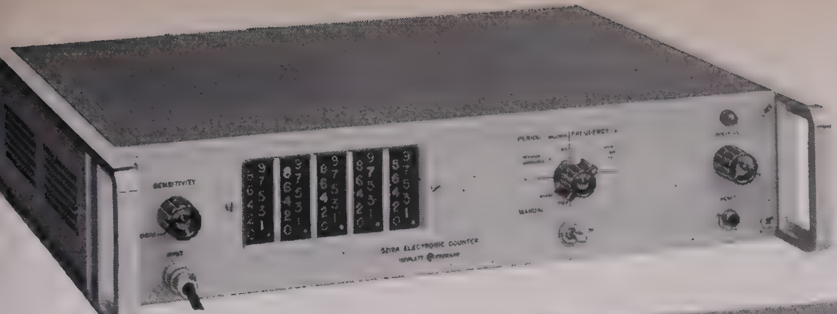
A unique display storage feature of these new counters produces a continuous visual readout of the most recent measurement, even while the instrument is making a new measurement. Only if the new count differs from the previous count will the display change, in which case it will shift directly to the new reading. The fatigue and error possibility of a "blinking" display is eliminated. The storage feature may be disabled with a rear panel switch.

The counter's "inactive time" (when not making a new measurement) is independent of gate time and adjustable from 0.2 to 5.0 seconds, thus permitting a higher sampling rate.

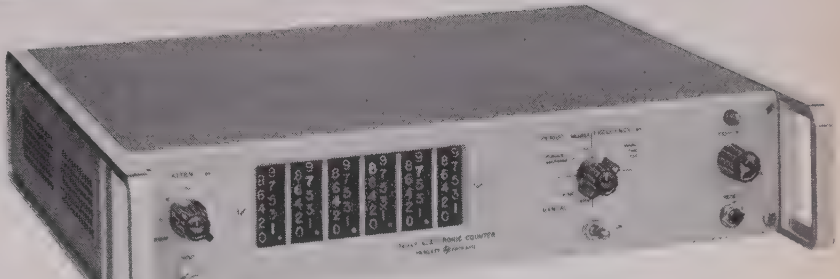
Counter	Max. Counting Rate	Registration	Perio	
			Range	Accuracy
5212A	300 KC	5 digits columnar	2 cps to 10 KC in single period; up to 300 KC in multiple period average	± 10 μs ± time base accuracy ± trigger error/ periods averaged
5512A	300 KC	5 digits Nixie		
5232A	1.2 MC	6 digits columnar	2 cps to 10 KC in single period; up to 1 MC in multiple period average	± 1 μs ± time base accuracy ± trigger error/ periods averaged
5532A	1.2 MC	6 digits Nixie		

High sensitivity permits low level measurement without accessories, and multiple period average measurement (to 100,000 periods) gives higher ac-

Note clean, compact, easy-to-service physical arrangement of new hp solid-state counters.



5212A, 300 KC



5232A, 1.2 MC

COUNTERS!

.Compact, easy-to-use instruments provide
.Solid-state dependability...Higher sampling rate
·65° C...Prices comparable to vacuum tube counters!

easurement		Frequency Measurement				Ratio Measurement			
Reads in	Periods Averaged	Range	Accuracy	Reads In	Gate Time	Reads	Range	Accuracy	Price
Millisec- nds with ositioned decimal	1, 10, 10^2, 10^3, 10^4, 10^5	2 cps to 300 KC	± 1 count ± time base accuracy	KC with positioned decimal	10, 1, 0.1, 0.01 sec.	(f_1/f_2) x period multiplier	f_1:100 cps to 300 KC (1 v rms into 1,000 ohms) f_2: same as period	± 1 count of f_1 ± trigger error of f_2	$ 975.00
									1,175.00
Milli- econds or icrosec- nds with ositioned decimal		2 cps to 1.2 MC					f_1: 100 cps to 1.2 MC (1 v rms into 500 ohms) f_2: same as period		1,300.00
									1,550.00

curacy in lower frequency ranges, even for noisy signals. Self-check is provided for both frequency and period measurement modes.

Only 3½" high, these counters are housed in the new ⓗⓟ modular cabinets ideal for both bench use and easy rack mounting. Routine maintenance is simple with snap-out decade/readout units and circuit cards. Readout drive directly from photoconductors eliminates a complete stage of complex circuitry, to effect genuine cost and reliability advantages. Compact design and construction and servicing ease are illustrated at the left.

Solid state design and construction gives you the advantages of low heat dissipation with minor heating effect on adjacent equipment, fast warm-up, low power consumption and new standards of reliability.

The new counters include a four-line BCD code output. This output, with assigned weights of 1-2-2-4, is available for systems use or to operate devices such as the ⓗⓟ 562A Digital Recorder. Front panel controls include Input Attenuation, Display, Reset and Function.

Call or write your ⓗⓟ representative or call us today for information and a demonstration!

Data subject to change without notice. Prices f.o.b. factory.

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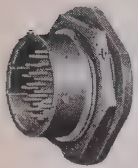
We like engineers who are never satisfied



Quality at Scintilla is more than a word—it's a positive attitude. We believe our electrical connector quality reflects our personal and business integrity. That's why engineers at Scintilla have the right—the obligation, actually—to say "no" to the smallest deviation in quality. We conduct continuous engineering research and development—seeking better designs and methods. We maintain one of the highest ratios of inspectors-to-production-workers in the industry. This close control over our electrical connector quality has done much to put us in a top position in an important market—and to make Bendix the brand most often selected for the most demanding jobs. We are confident our electrical connector customers will tell you that no company in the industry produces higher quality than does Scintilla. This acceptance, and our resulting volume, enables us to offer reliable product performance at prices that meet—or beat—any others. There's a lot more to be said on this subject of quality with economy. Give us a call!

Scintilla Division

SIDNEY, NEW YORK

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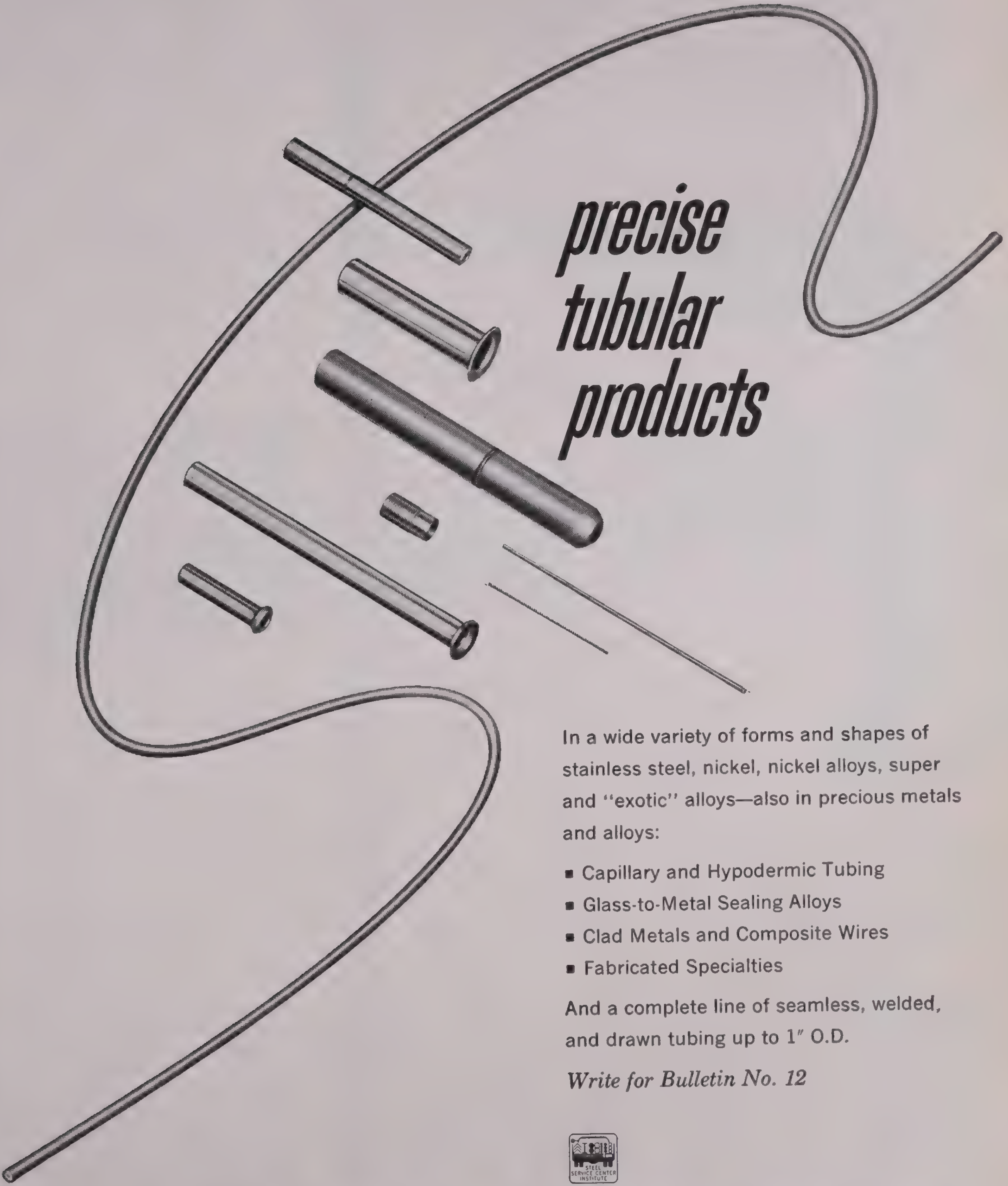

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Temperature Range—Full rating from —55°C to +85°C and to +125°C with 50% derating.

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Winding Construction—Extended foil (non-Inductive) MYLAR Dielectric.

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Tolerance—Standard ±20% ±10% ±5% thru ±1%.

Voltage Range—100, 200, 400, 600 and 1000 VDC.

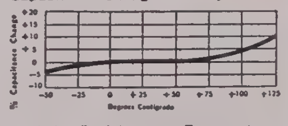
DIMENSIONS (100 Volt Rating)

CAP. MFD.	T	W	L
.022	.156	.297	5/8
.047	.219	.328	3/4
.1	.219	.359	7/8
.22	.328	.547	1
.47	.359	.672	1 1/4
1.00	.453	.859	1 1/2

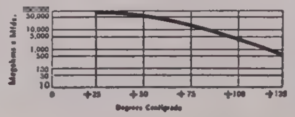
AXIAL LEADS

RADIAL LEADS

Capacitance Change vs. Temperature



Insulation Resistance vs. Temperature



*DuPont's trademark for polyester film.

GOOD-ALL ELECTRIC MFG. CO. Ogallala Nebr.
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Personals

National Electronics Conference annual award winners are: **Dr. Lawrence P. Huelsman**, Assoc. Professor of Electrical Engineering at University of Arizona and **Dr. Robert M. Lerner**, Assistant Group Leader, Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Mass.

Robert F. Garbarini—named Chief Engineer, Sperry Gyroscope Co.'s Air Armament Div., Great Neck, N. Y.

Philip C. Ross—appointed Engineering Manager, Switch Devices Section, Electro-Tec Corp., So. Hackensack, N. J.

Robert L. Sink—named Manager, Engineering for Burroughs Corp.'s Military Electronic Computer Div., Detroit, Mich.

R. L. Sink

H. F. Zaiss, Jr.

Herman F. Zaiss, Jr.—named Manager-Engineering Support, Traveling Wave Tube Product Section, General Electric Co., Palo Alto, Calif.

Trak Electronics Co., Inc., Wilton, Conn., announces the appointments of **Seymour Harrison** — Engineering Manager and **Norman Milkman**—Sr. Project Manager, Data Processing Engineering Dept.

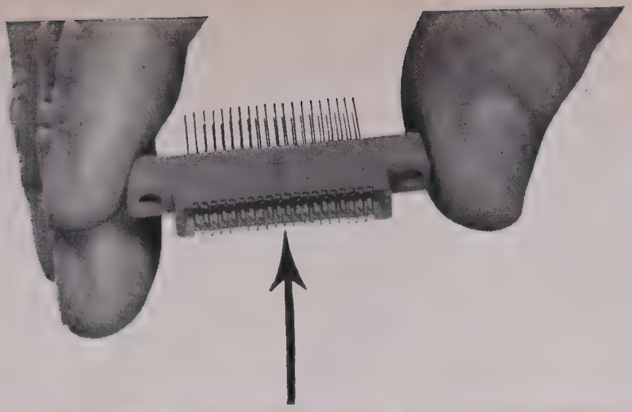
Robert J. Veale—appointed Manager, Radar Applications Engineering, Ground Systems Group, Hughes Aircraft Co., Fullerton, Calif.

Irving Charm—appointed Corporate Chief Engineer, Quality Control, Control Industries, Inc., Inwood, L. I., N. Y.

Telecomputing Corp., Los Angeles, Calif., announces the appointments of **Leonard P. Suffredini** — Product Development Mgr.; **Forest K. Milham**—promoted to Manufacturing Mgr., and **John H. McCann, Jr.** — Manager of Quality Control.

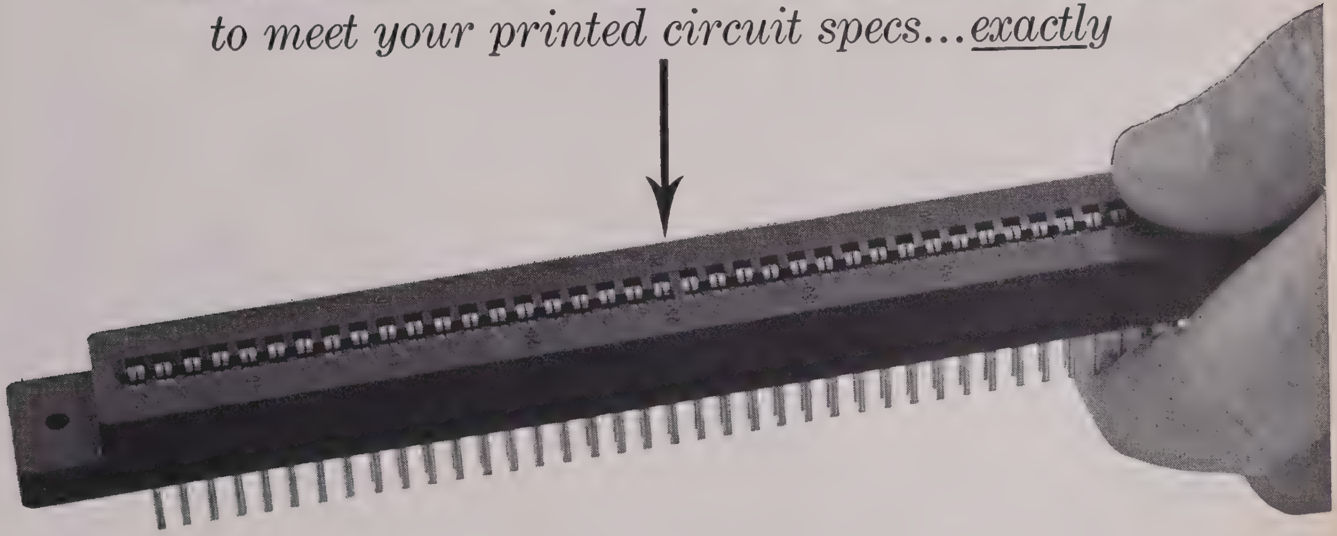
Allen C. Bluestein—appointed Director of Research, New Bedford Div., Aerovox Corp., Bedford, Mass.

Marcy Aynes — named Head, Production Engineering Section, Reliability Div. Engineering Dept., Pacific Semiconductors, Inc., Lawndale, Calif.



AND 67 SIZES IN BETWEEN

to meet your printed circuit specs...exactly



Continental's line of PC connectors include nearly seventy sizes and types. Name your requirement—and the chances are Continental has a standard production type that meets it *exactly.*

These service-proven connectors are available with up to 210 contacts, for 1/32, 3/64, 3/32, 1/16 and 1/8" PC boards, in both single- and double-row construction. Wiring styles include eyelet lug, wire wrap lug, taper tab and contacts for dip soldering. Continental's patented Bellowform contacts permit use of undersized or oversized boards while maintaining low contact resistance.

New PC connector designs are constantly under development. Our Engineering Department will be pleased to assist you in solving special connector problems. Simply call or write, stating your requirements.

DESIGNERS' DATA FILE

If you're designing around printed circuits you'll want to have Continental's Con-Dex File PC, compiled to help you select and specify the PC connectors best suited to your needs. For your copy, please write to: **Electronic Sales Division, DeJur-Amsco Corporation, Northern Boulevard at 45th St., Long Island City 1, New York (Exclusive Sales Agent) RAvenswood 1-8000.**

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Hughes Welders –

positive
answers
for
packaging
problems

RADIATION
INCORPORATED

RYAN
ELECTRONICS

GD
GENERAL DYNAMICS | ASTRONAUTICS

Leading aerospace electronic manufacturers have found welded modules made on Hughes welding equipment to be the answer to baffling component packaging problems.

These welded modularized packages give:

Reliabilty: Fracture tests prove welded joints are from 4 to 20 times stronger than soldered connections.

Contour Flexibility: Components can be arranged so final package is shaped to almost any configuration desired.

Light Weight / Small Size: Considerable reduction in both weight and volume over conventional packaging approaches.

Strength: Encapsulated package is rigid—resists destructive shock (1000 G's) and vibration (15 G's @ 10-2000 cps).

Low Cost: Competitive with all conventional techniques.

Availability: Here now! No waiting for research and development breakthroughs.

If you, too, are seeking answers to electronic packaging problems, see HUGHES complete line of welders. They are *production proved, voltage regulated* and *reasonably priced.*

Wire or write today for full information: **HUGHES, Vacuum Tube Products Division,** 2020 Short Street, Oceanside, California. For export information, write: HUGHES INTERNATIONAL, Culver City, California.

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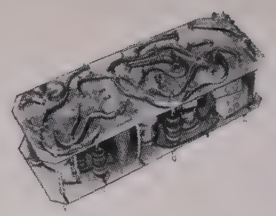
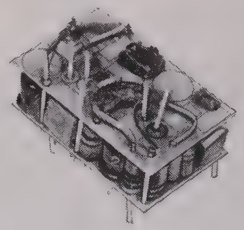
See Hughes welders at the WESCON Show—Booths 2427 & 3106



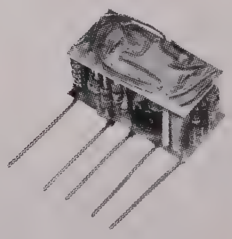
RADIATION
INCORPORATED

Engineers at Radiation Incorporated, Melbourne, Florida, describe this welded module made on Hughes equipment as the "heart" of an analog to digital converter. Included are a 175 KC free-running multivibrator and a synchronizer. This compact layout, they explain, allows circuit interconnections to be very short, an important factor to successful high frequency operation. Additional advantages cited were space and weight savings plus rigid environmental requirements.



RYAN
ELECTRONICS

Ryan Electronics, Ryan Aeronautical Company, San Diego, California, employs insulative wafers, point-to-point wiring and Hughes voltage regulated welders to assemble high density modules like the one shown above. This one contains a pulse generator, crystal oscillator and single flip-flop. Ryan engineers report that over-all system density exceeds 51 components per cubic inch in this particular application.



GD
GENERAL DYNAMICS | ASTRONAUTICS

Engineers at General Dynamics/Astronautics, San Diego, California, have selected Hughes welders for production of modules like the one shown above. The unit pictured is part of a pre-launch gyro rotation checkout system used on missiles built by the firm. Hughes voltage regulated welders were selected to provide the exact repeatability needed in making the reliable welds such applications demand.

Personals

General Electric's Silicone Products Dept., Waterford, N. Y., announces the promotions of **William C. Giegold** to Manager, Quality Control, and **Frank V. Summers** to Manager of Intermediates Process Engineering.

George W. Spencer—named Engineering Manager, Erie-Pacific Div., Erie Resistor Corp., Hawthorne, Calif.

Truman H. Cline—named Manager of Engineering, Stevens Mfg. Co., Inc., Mansfield, Ohio.

Maurice S. Hartley — appointed Manager of Cleveland Engineering Div., Brush Instruments, unit of Clevite Corp., Cleveland, Ohio.

M. S. Hartley

N. A. Moerman

Nathan A. Moerman—named Chief Engineer for Electronic Equipment, Kepco, Inc., Flushing, N. Y.

Pat Tucciarone — named Applications Engineer, PRD Electronic, Inc., Bklyn, N. Y.

Dr. Gilbert I. Addis—promoted to Assistant Direct, Vinyl Planning, Development Dept., Union Carbide Plastics Co., Div. Union Carbide Corp., Bound Brook, N. J.

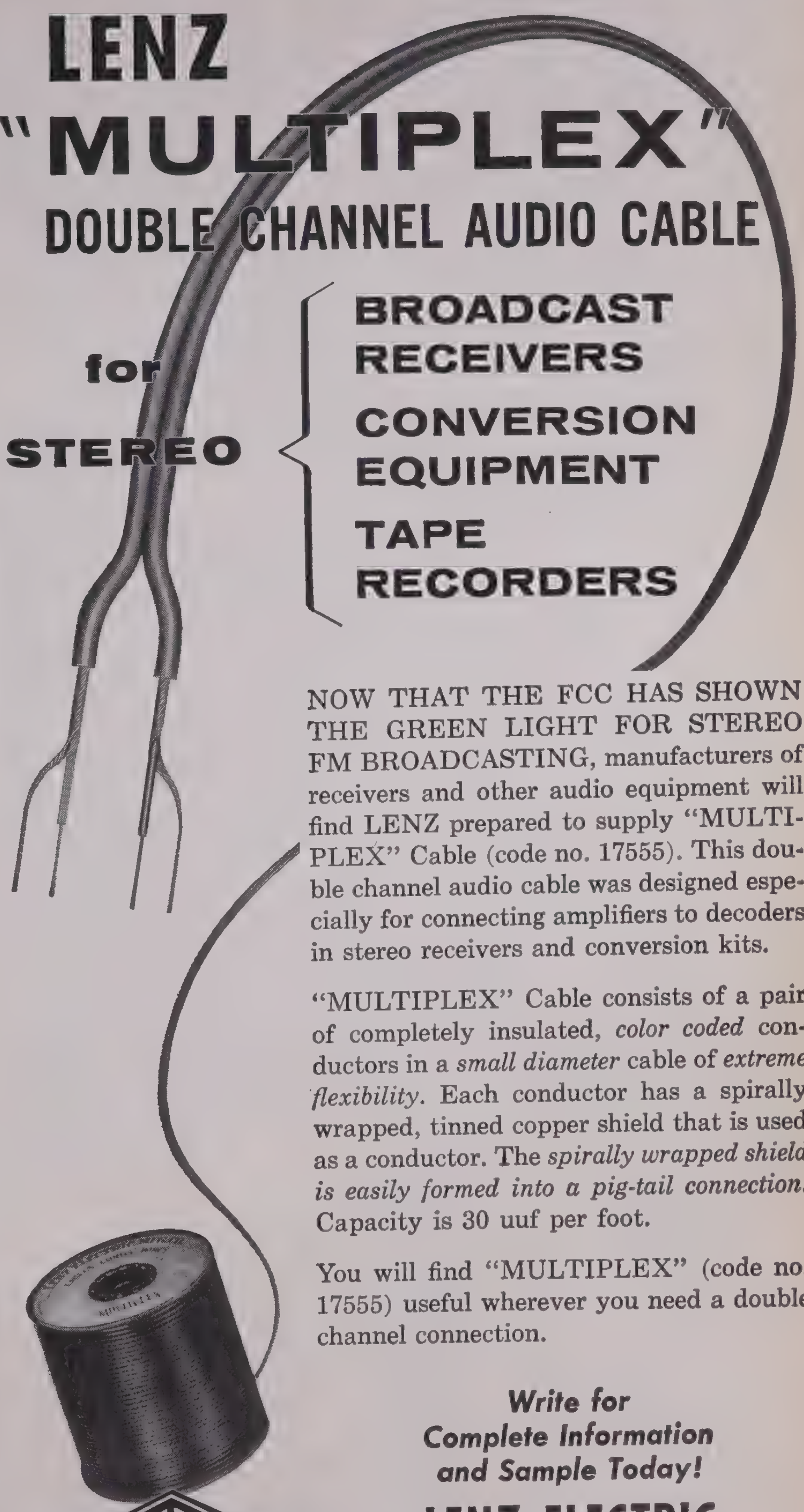
Sidney H. Linwood — promoted to Chief Engineer, Ferrite Engineering Dept., Stackpole Carbon Co., St. Marys, Pa.

International Resistance Co., Phila., Pa., announces the appointments of **George Stollsteimer** — Manufacturing Superintendent and **Thomas J. Sullivan**—Production Control Supervisor.

Dr. Ivor Brodie—named Fellow Engineer at Westinghouse Electronic Tube Div., Elmira, N.Y.

Adler Electronics, Inc., New Rochelle, N. Y., announces the appointments of **Kenneth P. Peterson**, Mgr., Systems Engineering, Military Products Div., and **Paul R. Breen**, Mgr., Engineering, Industrial Products Div.

Winfield E. Fromm—appointed Director, Research and Systems Engineering Div., Airborne Instruments Laboratory, Div. of Cutler-Hammer, Inc., Deer Park, L. I., N. Y.



FOR STEREOPHONIC FM RECEIVERS

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"MULTIPLEX"
DOUBLE CHANNEL AUDIO CABLE

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NOW THAT THE FCC HAS SHOWN THE GREEN LIGHT FOR STEREO FM BROADCASTING, manufacturers of receivers and other audio equipment will find LENZ prepared to supply "MULTIPLEX" Cable (code no. 17555). This double channel audio cable was designed especially for connecting amplifiers to decoders in stereo receivers and conversion kits.

"MULTIPLEX" Cable consists of a pair of completely insulated, *color coded* conductors in a *small diameter* cable of *extreme flexibility*. Each conductor has a spirally wrapped, tinned copper shield that is used as a conductor. The *spirally wrapped shield is easily formed into a pig-tail connection.* Capacity is 30 uuf per foot.

You will find "MULTIPLEX" (code no. 17555) useful wherever you need a double channel connection.

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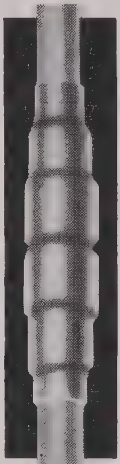
Shrinks Skin-tight Then Stops!

Alphlex Shrinkable Tubing shrinks, when heated, into a form-fitting, flexible insulation, tightly enclosing anything that has been placed within it. Slip it over a group of wires, exposed connection, even a tool handle that needs insulating — apply heat (135°C) for 7 seconds — watch it shrink smoothly and firmly to about 2/3 its former size. Further heating does not affect it. An irradiated, flame retardant, thermally stable, modified polyolefin, it retains all its properties indefinitely. Available in 20 standard sizes, #24 through 1" ID after shrinking, in varied colors.



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Zip Your Own Custom Cable In Seconds

with Alphlex Zipper Tubing. Lay your wires on a length of open Zipper Tubing . . . bring the edges together, and zzzzzzip! there's your cable, enclosed within a neat, waterproof, flame resistant covering that remains completely flexible at all times. To change conductors, Zipper Tubing opens and closes as often as necessary — and can be permanently sealed, when the design is set. Use it for quick identification of cables; for covering the main track and branches of a harness; as an extra, emergency outer jacket to protect against dust, abrasion, chemicals, or fumes. Available in 4 standard colors, 23 standard sizes, ¼" to 4" ID.

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30 sizes • 11 colors

Use Teflon insulation with its phenomenal operating temperature range (—90°C to +260°C), its immunity to high frequencies, and its adaptability to extreme miniaturization in all your plans: All 30 sizes (.012" to .330" ID) and 4 colors are in stock and immediately available at your Alpha distributor.
† E. I. Du Pont trademark

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Conforming to MIL-I-631C for 105°C uses, Alpha's PVC-105 is designed and manufactured specifically for electronic, aircraft, and electrical applications involving temperatures as high as 105°C. Forty sizes — nine colors in stock and immediately available at your Alpha Distributor.

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*Now . . . for ALPHLEX Teflon and Plastic Tubing . . .
- New convenience of storage and handling with new Alphlex see-through packaging

The new Alphlex tubing package lets you see at a glance what colors and sizes you have in stock . . . keeps your tubing clean and dust-free within transparent plastic envelope.

Write for free catalog.

OTHER TYPES OF ALPHLEX TUBING

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ALPHA electronic WIRE

ALPHA WIRE CORPORATION
Subsidiary of LORAL Electronics Corporation
200 Varick Street, New York 14, New York
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Circle 50 on Inquiry Card

Books

Transform Calculus for Electrical Engineers

By Roger Legros & A. V. J. Martin. Published 1961 by Prentice-Hall, Inc., Englewood Cliffs, N. J. 342 pages. Price $12.00.

This book deals with the Fourier series and integral, and Fourier and Laplace transforms, and their applications mainly in the field of electronics. Part I presents the Fourier Series and its applications, particularly to frequency spectra. Part II is devoted to the Laplace Transform and its applications. Part III treats the Laplace Transform method in the solution of linear circuits, especially the fundamental differentiating and integrating circuits. Part IV covers linear amplifiers and their frequency behavior.

Printed Circuits: Their Design and Application

By J. M. C. Dukes. Published 1961 by Macdonald & Co., (Publishers) Ltd., 16 Maddox St., London, W.1. 228 pages. Price $6.00.

As it is impossible in a small book to give a comprehensive account of all aspects of printed circuits, attention is specially directed to circuit and equipment design. Sufficient detail, however, is given for this book to be regarded as a first primer on manufacturing techniques, and considerable space is given to any fundamental electrical data which is of permanent value.

Error-Correcting Codes

By W. W. Peterson. Published 1961 by The Technology Press, M.I.T. and John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 285 pages. Price $7.75.

The book tells in detail how to implement codes in practical systems. Emphasis is on types of codes that have mathematical, especially algebraic structure. The mathematics necessary for understanding of coding theory is included in the book. It is addressed to engineers who require a thorough knowledge of coding.

Transistor Logic Circuits

By Richard B. Hurley. Published 1961 by John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 363 pages. Price $10.00.

The reader is led from elementary binary arithmetic and Boolean algebra through minimization techniques and implementation concepts in the first part of the book. This material is followed by a basic treatment of diodes and transistors and a section combining the mathematics with the devices into logic circuits. Sequential systems are realized for the reader with the author's presentation of applicable concepts and mathematics and, then, a treatment of circuits appropriate to these systems.

(*Continued on page* 78)

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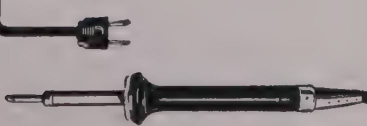

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HALF THE WEIGHT OF UNCONTROLLED IRONS

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COOLEST HANDLE

More than 40 tip types are available—made of copper for fast heat transfer and premium iron plated for long life. Advanced cord connection locks securely, yet permits easy replacement. Rubber shock absorber prevents iron from sliding off bench.

3 models cover all electrical and production line requirements

Model TC552-55 watts **$9.00** list
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WELLER ELECTRIC CORP. 601 STONE'S CROSSING RD., EASTON, PA.

Circle 51 on Inquiry Card

largest selection of adjustment potentiometers...

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More engineers specify Trimpot because:

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Bourns offers you the largest selection of leadscrew actuated potentiometers... 23 basic models—4 terminal types—three mounting methods.

Trimpot is small

Space saving size and rectangular shape permit the installation of 12 to 17 units in one square inch of panel area.

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Multi-turn screwdriver adjustment provides up to 9000° of rotation...you can make and repeat the finest adjustments.

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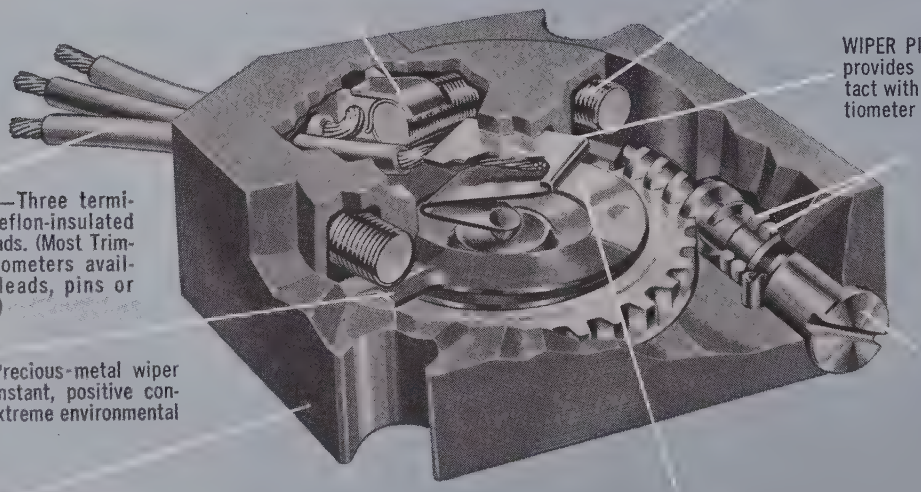
Trimpot is proved

It is used in more military and commercial equipment than any other leadscrew actuated potentiometer.

See these products and more at WESCON—Booth 3102-3104.

Only Trimpot potentiometers give you all of these outstanding features.



TERMINATION—Alloyed with multiple turns of the resistance wire, the exclusive Bourns Silverweld® termination is virtually indestructible under thermal or mechanical stress.

ELEMENT—Special metal mandrel is precision wound with low-temperature-coefficient resistance wire.

WIPER PICK-OFF—Spring pick-off provides positive electrical contact with wiper to improve potentiometer performance, reliability.

"O" RINGS—Two high-temperature silicone rubber "O" rings provide effective double seal against humidity.

TERMINALS—Three terminals are Teflon-insulated stranded leads. (Most Trimpot potentiometers available with leads, pins or solder lugs.)

CONTACT—Precious-metal wiper provides constant, positive contact under extreme environmental conditions.

ADJUSTMENT SCREW—Stainless steel leadscrew accommodates standard screwdriver, meets military requirements for salt spray.

BODY—High-temperature, thermosetting plastic body is sealed, enabling potentiometer to meet Mil Specs for humidity, sand, dust, fungus, salt spray, etc.

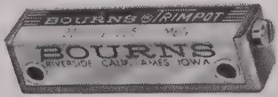
CLUTCH ASSEMBLY—Exclusive clutch design and positive stop at ends of wiper travel prevent internal mechanical damage.

This cutaway of Model 3250 is typical of the design of all Bourns Trimpot potentiometers though some features may vary from model to model.

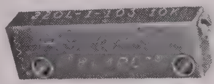
longest record of reliability

Potentiometers

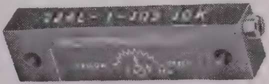
General-Purpose Wirewound Trimpot — Model 200. Operates at 105°C / L, S, P terminals / 0.25 watt / 10 ohms to 100K. Available as a rheostat, Model 201.



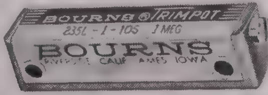
General-Purpose Resiston® Carbon Trimpot—Model 215. Operates at 125°C / L, S, P terminals / 0.25 watt / 20K to 1 Meg.



Subminiature Wirewound Trimpot—Model 220. Operates at 175°C / L, W, terminals / 1 watt / 100 ohms to 30K. Meets Mil Specs for humidity.

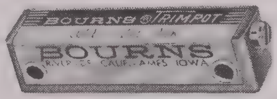


High-Temperature, Humidity-Proof Wirewound Trimpot—Model 224. Operates at 175°C / L, S, P terminals / 1 watt / 10 ohms to 100K. Meets Mil Specs for humidity. Also available in Resiston carbon as Model 3051 / 20K to 1 Meg.

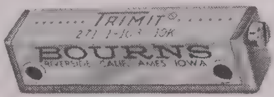


General-Purpose Resiston Carbon Humidity-Proof Trimpot—Model 235. Operates at 125°C / L, S, P terminals / 0.25 watt / 20K to 1 Meg. Meets Mil Specs for humidity.

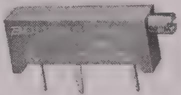
Humidity-Proof Wirewound Trimpot — Model 236. Operates at 135°C / L, S, P terminals / 0.8 watt / 10 ohms to 100K. Meets Mil Specs for humidity.



High-Temperature Wirewound Trimpot—Model 260. Operates at 175°C / L, S, P terminals / 1 watt / 10 ohms to 100K.



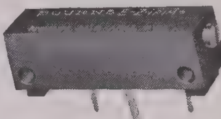
High-Quality Commercial Wirewound Trimit® — Models 271, 273, 275. Operate at 85°C / L, S, P terminals / 0.25 watt / 100 ohms to 10K. Resiston carbon versions also available, Models 272, 274, 276 / 20K to 1 Meg.



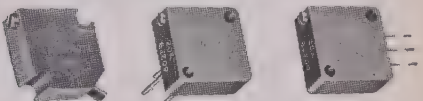
Subminiature High-Temperature Wirewound Trimpot — Model 3000. Operates at 175°C / tapered pin terminals / 0.5 watt / 50 ohms to 20K. Resiston carbon version available, Model 3001 / 20K to 1 Meg. Only ¾" long.

Write for detailed specifications and list of stocking distributors.

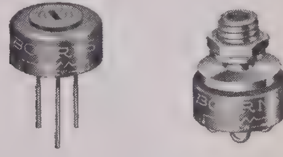
High-Temperature, Humidity-Proof Wirewound Trimpot — Model 3010. Operates at 175°C / L, P terminals / 1 watt / 10 ohms to 100K. Meets Mil Specs for humidity. Available in carbon as Model 3011 / 20K to 1 Meg.



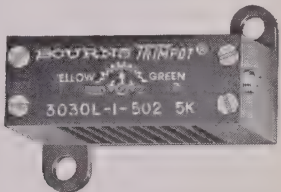
Low-Cost Commercial Wirewound E-Z Trim® — Model 3067. Operates at 85°C / L, S terminals / 0.5 watt / 100 ohms to 20K. Meets steady state humidity. Available in Resiston carbon as Model 3068 / 20K to 1 Meg. Priced under $1 in production quantities.



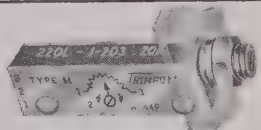
Subminiature Humidity-Proof Wirewound Trimpot — Model 3250. Operates at 175°C / L, 3 types of P terminals / 1 watt / 100 ohms to 50K. Meets Mil Specs for humidity.



½" Wirewound Single-Turn Potentiometer — Model 3367. Operates at 105°C / P, S terminals with panel mount collar / 0.5 watt / 100 ohms to 20K. Meets steady state humidity.



High-Power Wirewound Trimpot — Model 3030. 15 watts. Operates at 265°C / L terminals / 10 ohms to 10K.



PANEL MOUNTED UNITS — All models except 3250 are now available with panel mounting. Unique design permits quick factory assembly to "on-the-shelf" units. In addition, mounting screws, mounting brackets and clip brackets are available from factory or distributor stock to meet virtually any mounting situation.

Key to terminal types:
L = Insulated stranded leads
S = Solder lugs (includes 3367S, panel mount bushing only)
P = Printed circuit pins
W = Uninsulated wires

The following resistances are standard if they fall within the limits listed: 10 20 50 100 200 500 1K 2K 5K 10K 20K 25K (wirewound only) 50K 100K 200K 500K 750K 1 Meg. Other resistances available on special order.

BOURNS

BOURNS, INC., TRIMPOT DIVISION
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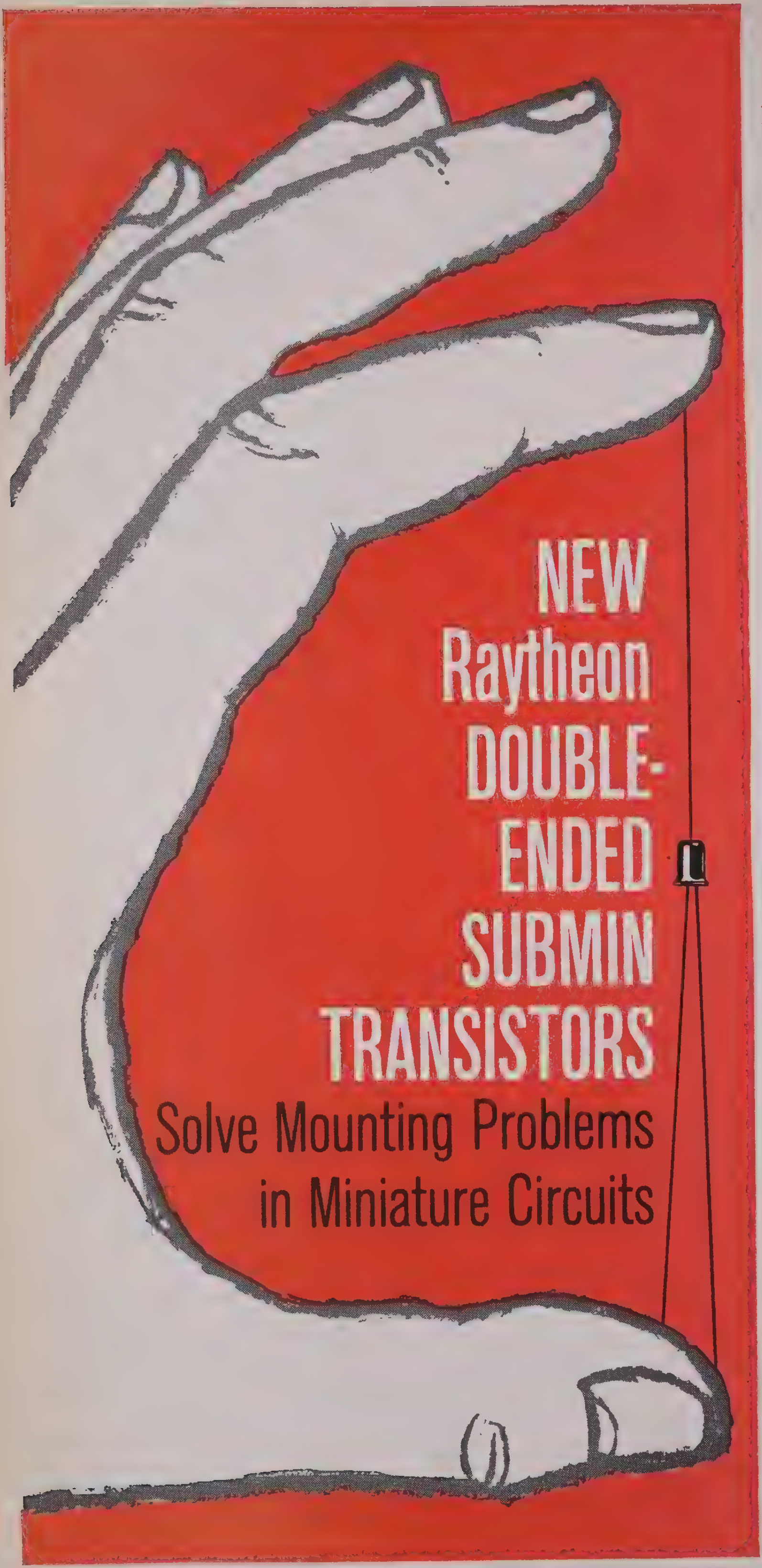
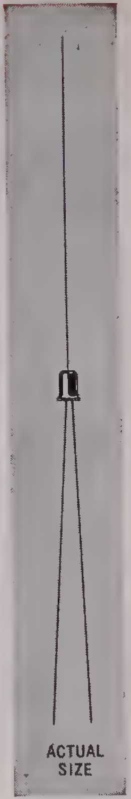
PHONE: OVERLAND 4-1700 • TWX: RZ9222
CABLE: BOURNSINC.

Manufacturer: Trimpot® potentiometers; transducers for position, pressure, acceleration. Plants: Riverside, California; Ames, Iowa; and Toronto, Canada

Circle 52 on Inquiry Card



Important addition to the most complete submin line in the industry



More than 21 times smaller than the standard TO-5 case, these new Raytheon germanium NPN and PNP and silicon NPN types provide both the small size and mounting flexibility required for advanced techniques in miniature packaging. This double-ended feature lends itself to new design freedom in single and multiple-board configurations. New solutions are possible for feed-through construction applications, welded assembly needs, and other assembly problems, such as jump wiring, and input-output isolation.

You can now choose from 52 ultra-reliable submin transistors. NPN and PNP, germanium and silicon, single-end and double-end — immediately available for large quantity orders at low cost. Complete technical and sales information can be obtained from the Raytheon office nearest you.

GERMANIUM

TO-5	Double-Ended	TO-5	Double-Ended
2N404 PNP	2N800	2N422 PNP	CK22C
2N426 PNP	2N802	2N464 PNP	CK64C
2N427 PNP	2N804	2N465 PNP	CK65C
2N428 PNP	2N806	2N466 PNP	CK66C
2N582 PNP	2N808	2N467 PNP	CK67C
2N414 PNP	2N810	2N438 NPN	2N818
2N416 PNP	2N812	2N439 NPN	2N820
2N417 PNP	2N814	2N440 NPN	2N822
2N396 PNP	2N826	2N1605 NPN	2N824

SILICON

TO-5	Double-Ended	TO-5	Double-Ended
2N337 NPN	2N907	2N334 NPN	2N904
2N338 NPN	2N908	2N335 NPN	2N905
2N332 NPN	2N902	2N336 NPN	2N906
2N333 NPN	2N903		

For applications assistance, call offices listed below. For immediate availability and condensed data, call Distributors listed on opposite page.

RAYTHEON

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DETROIT, MICH., TRinity 3-5330 • ENGLEWOOD CLIFFS, N. J., LOwell 7-4911 (Manhattan, WIsconsin 7-6400) • LOS ANGELES, CAL., PLymouth 7-3151 • ORLANDO, FLA., GArden 3-0518
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GOVERNMENT RELATIONS: Washington, D. C., MEtropolitan 8-5205

Circle 53 on Inquiry Card

Contact your Raytheon Distributor for off-the-shelf delivery at no penalty in price on Raytheon Double-Ended Submin Transistors and all Raytheon Semiconductors. Raytheon, Distributor Products Division, 411 Providence Turnpike, Westwood, Massachusetts.

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Birmingham
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  East Coast Radio & Televison Co.
    CHerry 1-9655
West Palm Beach
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  Mid-State Distributors
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    COpley 7-4700
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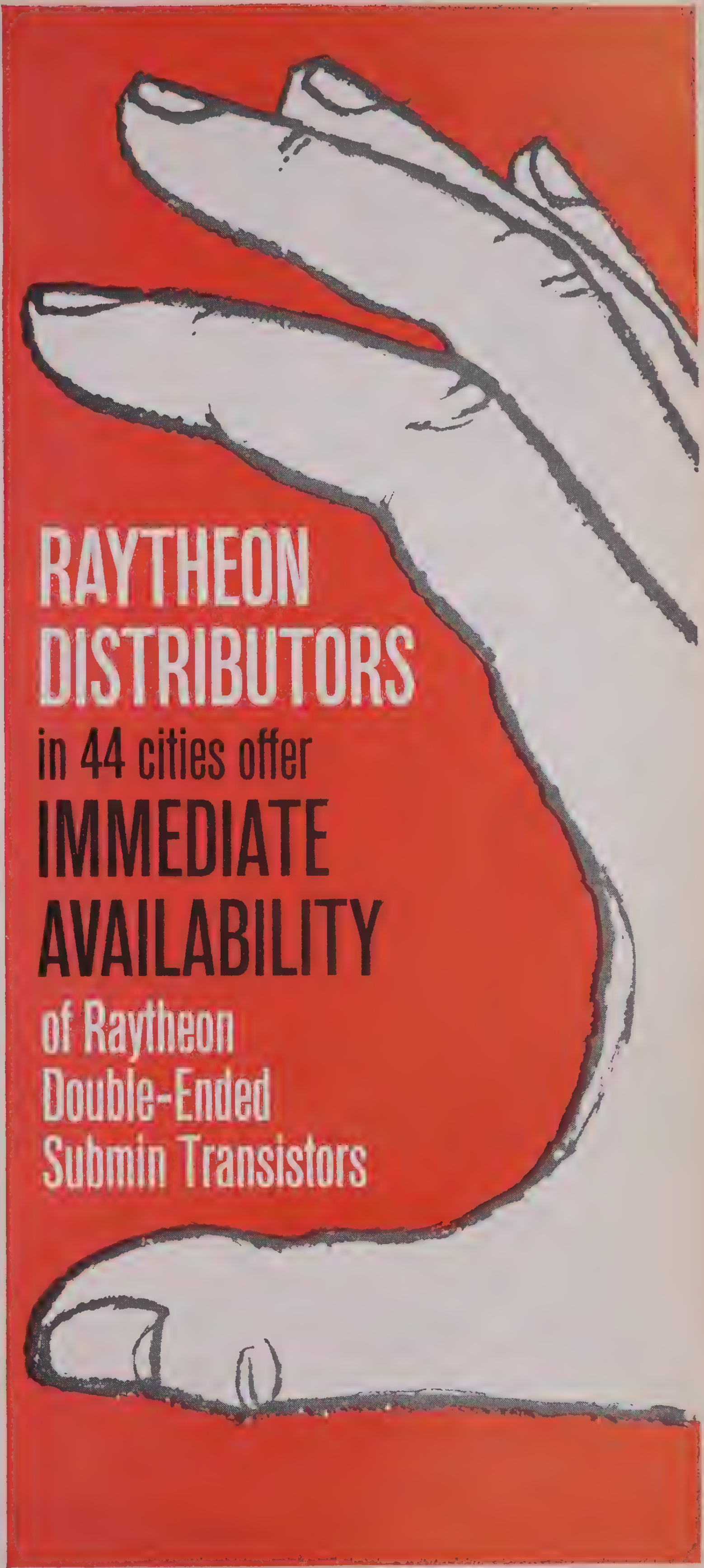

RAYTHEON COMPANY

DISTRIBUTOR PRODUCTS DIVISION

RAYTHEON

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3 in 1

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• DARK TRACE DISPLAY

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NON-STORING DYNAMIC CURSOR

DARK TRACE WRITING

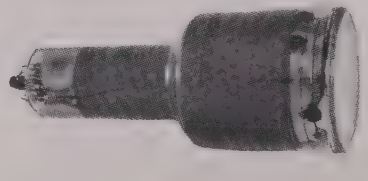
With this Hughes *Multi-Mode* TONOTRON* Tube you can now:

- **Maintain continuous optimum display brightness**
- **Present dynamic cursors on stored displays**
- **Produce dark trace line or half-tone images**
- **Selectively eliminate screen clutter**
- **Get resolution in excess of 125 lines per inch in dark trace writing mode.**

The new Hughes *Multi-Mode* Storage Tube retains all of the characteristics of the TONOTRON* storage tube—controllable persistence, high picture brightness, full half-tone (grey) scale—and gives you the *added advantages* of selective erasure, simultaneous presentation of stored and non-stored information and high resolution dark trace writing.

For information on the new Hughes *Multi-Mode* Storage Tube, write or wire today: HUGHES, Vacuum Tube Products Division, 2020 Short Street, Oceanside, Calif. For export information, write: Hughes International, Culver City, California.

*Trademark Hughes Aircraft Company



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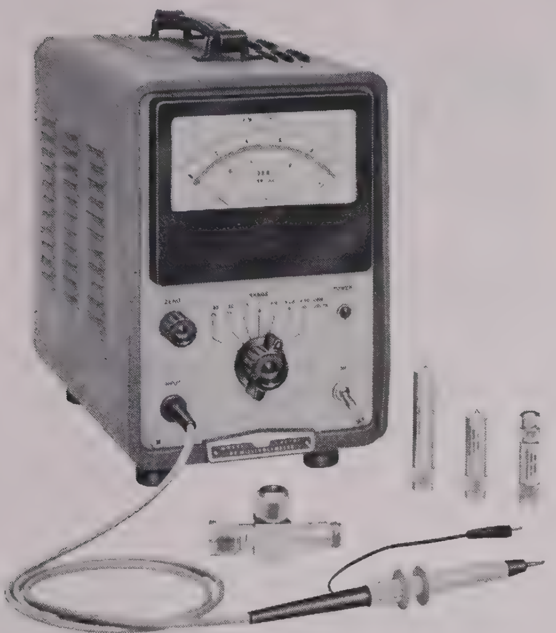
HUGHES

HUGHES AIRCRAFT COMPANY
VACUUM TUBE PRODUCTS DIVISION

See the complete line of HUGHES storage tubes at WESCON—Booths 3106-8

Circle 55 on Inquiry Card

Now, with one instrument, you can instantly measure 1 mv at 1,000 mc!



Specifications

Voltage Range:	10 mv rms full scale to 10 v rms full scale in seven ranges. Full scale readings of 0.01, 0.03, 0.1, 0.3, 1, 3 and 10 v rms.
Frequency Range:	500 KC to 1 GC with accessory probe tips. Usable indications to 4 GC.
Accuracy:	1 MC to 50 MC, ±3% of full scale; 50 MC to 150 MC, ±6% of full scale; 500 KC to 1 GC, 1 db.
Meter Scales:	Two linear voltage scales, 0 to 1 and 0 to 3, calibrated in the rms value of a sine wave. Db scale, calibrated from +3 to −12 db; 0 db = 1 mw in 50 ohms.
Probe Tips Furnished:	BNC open circuit tip 0.5 MC to 500 MC; Pen Type Probe Tip, 500 KC to 50 MC. Shunt capacity: < 4 pf. Max. input: 300 v dc.
Galvanometer Recorder Output:	Proportional to meter deflection, 1 ma into 1000 ohms at full scale deflection.
Power:	115/230 v ±10%, 50 to 60 cps, 35 watts.
Dimensions:	Cabinet Mount: 11¾" high, 7½" wide, 12" deep. Rack Mount: 6 31/32" high, 19" wide, 10⅜" deep behind panel.
Price:	ⓗⓟ 411A, (cabinet) $450.00. ⓗⓟ 411AR (rack mount) $455.00.

Data subject to change without notice.
Price f.o.b. factory.

or any rf voltage 1 mv to 10 v, from 500 KC to 1,000 MC. Measuring is as simple as "touch and read;" resolution is high, thermal drift errors are virtually eliminated!

Now, easily and dependably and with utmost accuracy, you can measure millivolts at rf frequencies — and on one simple-to-use instrument, ⓗⓟ 411A Voltmeter. This remarkable instrument has true linear operation (no correcting networks) and readings are presented on a large, mirror-backed linear meter. Temperature stability is such that there is virtually no change from 10° to 40° C.

Specifications alongside indicate basic features of this important new, time-saving instrument. Other special features include (a) matched diodes protected against burnout (b) probe temperature compensated for low drift (c) ⓗⓟ amplifier photochopper eliminating contact noise, guaranteeing high sensitivity and zero-drift freedom (d) extra probe tips available including a 500 KC to 250 MC tip; 100:1 Capacity Divider tip, and Type N Tee tip for coax use to 1,000 MC.

Why tolerate a complex, cumbersome voltmeter. Get a new ⓗⓟ 411A into action on your bench now!

HEWLETT-PACKARD COMPANY
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6955

• Reduced Saturation Voltage! • Reduced Storage Time!

epitaxial

• GERMANIUM

2N781 2N782

Refined by intensive research, proven by extensive testing—Sylvania Epitaxial Mesa Transistors offer extraordinary performance characteristics. They combine the high electrical and mechanical reliability, power dissipation capabilities, and fast switching speed of the mesa *with* the low saturation voltage, reduced collector capacitance, decreased storage time, and high gain at high current levels that are characteristic of the epitaxial process. Electrical uniformity, too, is superior because the epitaxial technique is ideally suited to the highly automated, modern production facilities of Sylvania. Result: remarkable high-speed switching and high-frequency amplifying devices that illustrate the dramatic advances being made in the solid state art at Sylvania.

SYLVANIA 2N781—WORLD'S FASTEST PNP GERMANIUM SWITCHING TRANSISTOR

. . . is designed specifically for circuits with high speed and low saturation voltage as prime performance features. Sylvania 2N782 offers similar electrical characteristics at lower unit cost.

ABSOLUTE MAX. RATINGS (AT 25°C)

	2N781	2N782	UNIT
Collector to Base Voltage	—15	—12	V
Collector to Emitter Voltage	—15	—12	V
Emitter to Base Voltage	—2.5	—1.0	V
Collector Current	100	100	mA
Power Dissipation (free air)	150	150	mW
Power Dissipation (case at 25°C)	300	300	mW
Storage Temperature	—65 to +100	—65 to +100	°C
Junction Temperature	+100	+100	°C

ELECTRICAL CHARACTERISTICS (AT 25°C)

Symbol	Conditions	2N781 Min.	2N781 Max.	2N782 Min.	2N782 Max.	UNIT
BV_{CBO}	$I_c = -100\ \mu A, I_E = 0$	—15	—	—12	—	V
BV_{EBO}	$I_E = -100\ \mu A, I_c = 0$	—2.5	—	—1.0	—	V
BV_{CES}	$I_c = -100\ \mu A, V_{BE} = 0$	—15	—	—12	—	V
h_{FE}	$I_c = -10$ mA $V_{CE} = -0.22$ V	25	—	—	—	
h_{FE}	$I_c = -10$ mA $V_{CE} = -0.25$ V	—	—	20	—	
V_{BE}	$I_c = -10$ mA, $I_B = 0.4$ mA	—0.34	—0.44	—0.34	—0.50	V
I_{CBO}	$V_{CB} = -5$ V, $I_E = 0$	—	—3.0	—	—3.0	µA
V_{CE} (Sat.)	$I_c = -10$ mA, $I_B = -1$ mA	—	—0.16	—	—0.20	V
	$I_c = -100$ mA, $I_B = -10$ mA	—	—0.25	—	—0.45	V
$t_d + t_r$	$V_{BE(o)} = 0.5$ V, $I_{B(1)} = -1$ mA	—	60	—	75	mµsec
t_s	$V_{CC} = -3.5$ V, $R_c = 300$ ohms	—	20	—	35	mµsec
t_f	$I_{B(2)} = 0.25$ mA	—	50	—	75	mµsec

AT WESCON—see the Sylvania exhibit, Booth #3201, 3, 5, 7, 9, 11, 3302, 4, 6, 8,

Explore the advantages offered your designs by performance-proved Sylvania Epitaxial Mesa Transistors. *Available from your* Sylvania Sales Engineer or Sylvania Franchised Semiconductor Distributor now! For technical data, write Semiconductor Division, Sylvania Electric Products Inc., Dept. 198, 1100 Main Street, Buffalo 9, N. Y.

mesas

•SILICON

2N783 2N784

Sylvania offers both!

TO–18 shown three times actual size

SYLVANIA 2N783—WORLD'S FASTEST NPN SILICON SWITCHING TRANSISTOR

. . . is designed specifically for circuits with high speed as a prime performance feature. Sylvania 2N784 delivers low saturation voltage combined with exceptional high-speed capabilities.

ABSOLUTE MAX. RATINGS (AT 25°C)

	2N783	2N784	UNIT
Collector to Base Voltage	40	30	V
Collector to Emitter Voltage	20	15	V
Emitter to Base Voltage	5	5	V
Collector Current	50	50	mA
Power Dissipation (free air)	300	300	mW
Power Dissipation (case at 25°C)	1	1	W
Storage Temperature	–65 to +300	–65 to +300	°C
Junction Temperature	+175	+175	°C

ELECTRICAL CHARACTERISTICS (AT 25°C)

		2N783		2N784		
Symbol	Conditions	Min.	Max.	Min.	Max.	UNIT
BV_{CBO}	$I_C = 100\ \mu A, I_E = 0$	40	—	30	—	V
BV_{EBO}	$I_C = 100\ \mu A, I_C = 0$	5	—	5	—	V
BV_{CER}	$I_C = 10\ \mu A, V_{BE} = 0, R_{BE} = 10$ ohms	20	—	15	—	V
I_{CBO}	$V_{CB} = 25$ V	—	250	—	250	mμA
	$V_{CB} = 25$ V, T = 150°C	—	30	—	30	μA
h_{FE}	$I_C = 10$ mA, $V_{CE} = 1$ V	20	60	25	—	
V_{BE}	$I_C = 10$ mA, $I_B = 1$ mA	0.7	0.9	0.7	0.9	V
V_{CES}	$I_C = 10$ mA, $I_B = 1$ mA	—	.25	—	.16	V
C_{ob}	$V_{CB} = 10$ V, $I_E = 0$, F = 1 MC	—	3.0	—	3.5	μμf
h_{fe}	$V_{CB} = 15$ V, $I_c = 10$ mA, F = 100 MC	2.0	—	2.0	—	
t_{on}	$I_{B(1)} = 3$ mA, $I_{B(2)} = 1$ mA $V_{CC} = 3$ V, $R_L = 270\ \Omega$	—	18	—	20	nsec
t_s	$I_{B(1)} = 10$ mA, $I_{B(2)} = 10$ mA $V_{CC} = 10$ V, $I_C = 10$ mA, $R_L = 1000\ \Omega$	—	10	—	15	nsec
t_{off}	$I_{B(1)} = 3$ mA, $I_{B(2)} = 1$ mA $V_{CE} = 3$ V, $R_L = 270\ \Omega$	—	30	—	40	nsec

SYLVANIA

SUBSIDIARY OF

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GENERAL SYSTEM

Precision Measurement Demands

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instruments

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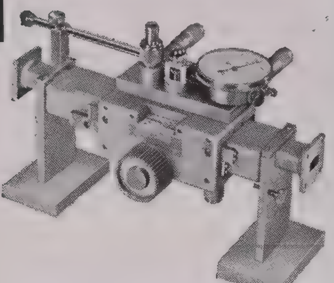
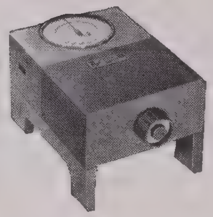
TRANSITIONS
GAIN HORNS
WAVEGUIDE SWITCHES





and **components**

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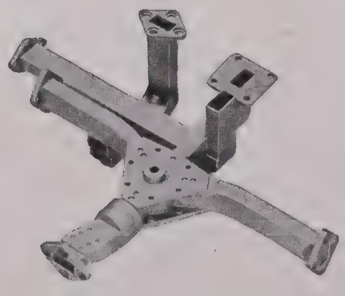


Consult Waveline in order to achieve maximum compliance with your complex waveguide requirements. Standard instruments and special components are available.

WAVELINE INC.
CALDWELL, NEW JERSEY
Phone: CApital 6-9100 TWX Caldwell, N. J. 703

Circle 57 on Inquiry Card

Books

(*Continued from page* 68)

Mathematical Handbook for Scientists and Engineers

By Granino A. Korn and Theresa M. Korn. Published 1961 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 943 pages. Price $20.00.

This book gives quick, reliable reference to helpful definitions, theorems, and formulas, and conveniently outlines the mathematical methods essential for accuracy and speed in today's exacting applications. Among the many subjects covered are algebra, analytic geometry, calculus, vector analysis, integrals, Fourier analysis, Laplace transformations, differential equations, Boolean algebra, tensor analysis, probability theory, random processes, correlation functions, numerical computation, and finite-difference methods.

Important definitions and formulas are collected in tables and boxed groups for rapid reference and review. Besides the reference material, the book provides a connected survey of mathematical methods. Throughout suitable introductions, notes, and cross-references show the interrelations of the various topics and their importance in science and engineering work.

The Consulting Engineer

By C. Maxwell Stanley. Published 1961 by John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 258 pages. Price $5.95.

This book is divided into two main sections. Part I is concerned primarily with the consulting engineer's professional relationships to his client, to other consultants, and to the public. Part II deals with internal problems of a consulting practice. Emphasis is placed on the problems related to the operation of a consulting engineering practice, and not on the technical engineering problems involved in construction and design.

Elements of Maser Theory

By Arthur A. Vuylsteke. Published 1960 by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 362 pages. Price $9.50.

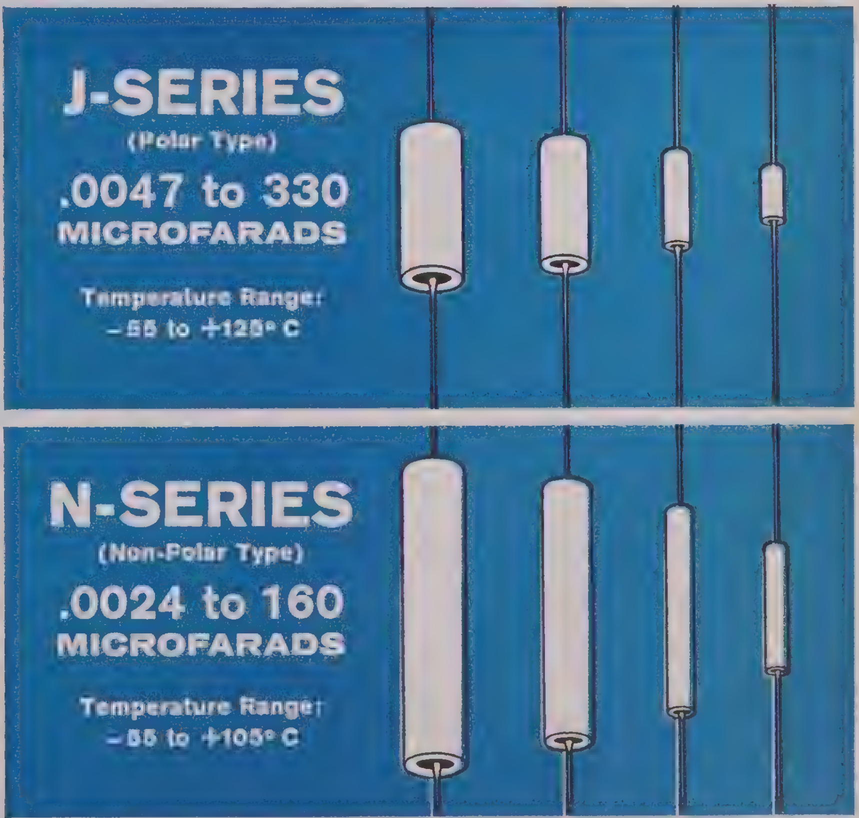
Organized into three main parts, the author first surveys the basic phenomena responsible for maser behavior with a brief description of the Bohr quantum theory and of statistical mechanics. Part two covers as much of the theory of quantum mechanics, statistical mechanics and radiation theory as will be found helpful in further readings. Here, a postulational or axiomatic approach is employed for conciseness of presentation. Part three is limited to a reasonably complete theoretical treatment of the most basic and currently well understood features of masers.

(*Continued on page* 80)

75v 60 50 35 20 15 10 6

Only "KEMET" has the widest choice of High-Voltage SOLID TANTALUM CAPACITORS

...at LOW Microfarad Values!



J-SERIES
(Polar Type)

.0047 to 330 MICROFARADS

Temperature Range: −55 to +125° C

N-SERIES
(Non-Polar Type)

.0024 to 160 MICROFARADS

Temperature Range: −55 to +105° C

J-Series meets or exceeds MIL-C-26655A

KEMET offers you the only full line of high-voltage solid tantalum capacitors for a multitude of military/industrial applications. J-Series and N-Series are available in working voltages of 75, 60, 50, 35, 20, 15, 10, and 6—in standard E.I.A. values with ±5%, ±10%, and ±20% tolerances. Low leakage characteristics are excellent. Four J-Series case sizes conform to MIL-C-26655A—with or without insulating sleeve. Leads are solderable and weldable. All KEMET types have passed approved environmental tests. Whatever your solid tantalum capacitor needs, meet them with KEMET's complete line! Kemet Company, Division of Union Carbide Corporation, 11901 Madison Avenue, Cleveland 1, Ohio.

Write for technical data on the
complete line of "KEMET"
Solid Tantalum Capacitors!

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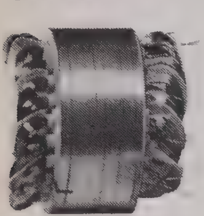
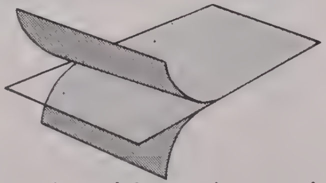
NEW COATED GLASS INSULATION SURVIVES CLASS F PUNISHMENT



"Irvington" Brand Epoxy Coated Glass No. 2525 is an exceptional insulation for electrical equipment that operates continuously at high temperatures. Retains its electric strength and flexibility even after sustained aging at class F temperatures and is particularly suited for use in epoxy impregnated or cast units.

Extremely flexible and snug conforming, No. 2525 offers excellent compatibility with epoxy systems and will not contaminate or degrade transformer oils. In tape, sheet or roll form in thicknesses of .003", .007" or .010".

NEW LAMINATED WEB/FILM/WEB INSULATION IS ADHESIVE FREE



"Irvington" Brand Polyester Laminate No. 2541, a unique 100% polyester web/film/web construction, is formed without an adhesive. Eliminates the major cause of delamination and allows better resin penetration.

No. 2541 provides constant dielectric strength under high humidity conditions and prevents moisture entrapment during encapsulation or dipping. Non-woven web is free of adhesives or contaminants and completely compatible with varnishes or encapsulating resins for maximum absorptivity. Tough three layer construction withstands rough handling in cuffing or forming operations. Available in .007", .010" and .015" thicknesses to meet all electrical and mechanical needs. For further information on these insulations write: 3M Company, 900 Bush Ave., St. Paul 6, Minn. Dept. ECB-81.

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Irvington Division
MINNESOTA MINING AND MANUFACTURING COMPANY
...WHERE RESEARCH IS THE KEY TO TOMORROW
3M COMPANY

Circle 69 on Inquiry Card

Books

(Continued from page 78)

Foundation for Electric Network Theory

By Myril B. Reed. Published 1961 by Prentice-Hall, Inc., Englewood Cliffs, N. J. 354 pages. Price $13.00.

By using only algebra and real numbers, the author makes it possible for the reader to concentrate on professional language, concepts, and symbolisms, rather than on mathematical complexities. In general, this book provides an unusually broad base for network theory.

The author includes several aids to learning: introductions and summaries emphasize the main points of each chapter; detailed examples appear throughout; problems are included for every chapter; and the appendix provides the necessary principles of matrix algebra.

Books Received

Progress in Dielectrics, Vol. III

By J. B. Birks. Published 1961 by John Wiley & Sons, Inc., 440 Park Ave., South, New York 16, N. Y. 292 pages. Price $10.00.

Governmental Publications

Orders for reports designated (OTS) should be addressed to the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Make check or money order payable to: "OTS, Dept. of Commerce." OTS reports may also be ordered through the Dept. of Commerce Field Offices. Prepayment is required. Use complete title and PB number for each report ordered. All other reports may be ordered from the Supt. of Documents, Government Printing Office, Washington 25, D. C.

Recent Developments in Casting Resins and Technology for Electrical Encapsulation Applications

Plastics Technical Evaluation Center, Picatinny Arsenal, N. J., for Department of Defense. Nov. 1960. 34 pages. PB171034.

An Introduction to Digital Computers

B. F. Green, Jr., Lincoln Laboratory, M.I.T., for Computers Committee, American Psychological Association, and U.S. Armed Forces under contract to the Air Force. August 1960. 46 pages. PB171100. Price $1.25.

Testing Continuous Computers

R. C. Mikulich, Institute for Systems Research, University of Chicago, for Wright Air Development Center, U.S.A.F. Feb. 1958. 208 pages. PB171080. Price $3.50.

Test of a Model Dynamic System Synthesizer

R. C. Mikulich, Institute for Systems Research, University of Chicago, for Wright Air Development Center, U.S.A.F. Feb. 1958. 175 pages. PB 171144. Price $3.00.

New! Sylvania CT4251

First

Compact

Decade Counter Tube

in Dome-Shaped T-9 Bulb

with 10 Output Cathodes

Illustration compares size advantage of Sylvania CT4251 to type in T-11 outline

Sylvania introduces the new CT4251 . . . opening a dramatic new approach to the design of very compact, low-cost counting equipment in the 0-50KC frequency range.

Utilizing a new dome-shaped T-9 bulb evacuated from the base, Sylvania CT4251 offers significant reductions in seated height. CT4251 features 10 output cathodes, offering the versatility and advantages of tube types previously available only in the T-11 bulb. Examples: electrical information can be fed from all 10 cathodes, enabling preselection of a count from 0-9; the diameter of the ring of cathodes is identical with that of types in the T-11 outline, providing excellent visibility of readout information.

Sylvania CT4251 is the lowest cost *cold cathode Decade Counter Tube* available. Combining electrical and visual readout functions, it offers extensive economies in circuitry and associated components. Sockets, too, for its 13-pin circle are as much as one-half the cost of sockets normally required for T-11 types. In addition, this new 13-pin circle makes it possible for Sylvania CT4251 to be designed into equipment using transistorized and printed circuit techniques.

Tests to date of Sylvania CT4251 indicate superior quality performance even under stand-by operation for 500 hours.

Your Sylvania Sales Engineer will be pleased to tell you more. Contact him or write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 198, 1100 Main St., Buffalo 9, N. Y.

Sylvania Type	Total Anode Current (mA)		Min. Anode Supply Voltage (Vdc)	Min. Double Pulse Amplitude (V)	Min. Double Pulse Width (μsec)
	Min.	Max.			
CT4251	0.65	0.8	400	–70	4

SYLVANIA

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SYSTEM

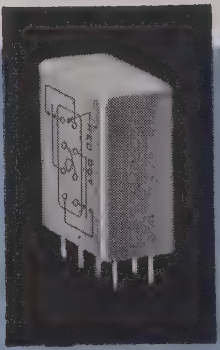
For Long Life and Power Economy

Specify the NEW **CLARE** **LATCHING** *SUBMINIATURE* *crystal can* **RELAY**

The new CLARE Type LF, magnetic latching subminiature relay offers designers simplified circuitry in small space by providing latching effect without transistors. Magnetic latching results in power economy.

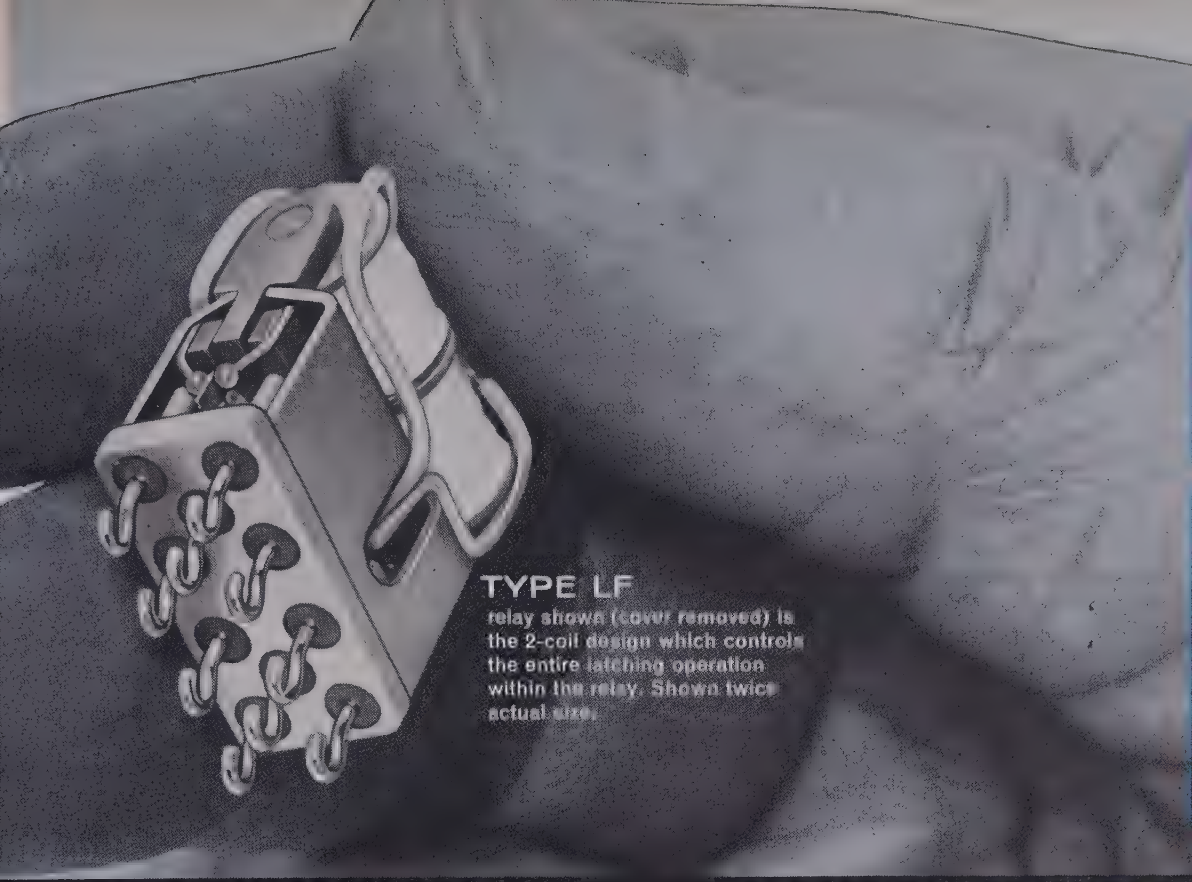
The Type LF is available with either 2-coil or 1-coil configuration. The 2-coil relay allows complete control of the latching operation within the relay and provides an extremely compact operating unit. The 1-coil relay is somewhat more sensitive; it is adaptable to existing circuits where outside control is provided. (See opposite page for specifications and circuit diagrams.) The Type LF provides the same wide range of mounting arrangements and terminals as the CLARE Type F relay.

FOR NON-LATCHING OPERATION



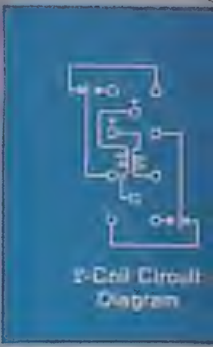
CLARE Type F Subminiature Crystal Can Relay

The CLARE Type F relay is extremely fast and more than moderately sensitive. It is built to withstand temperature extremes, heavy shock and extreme vibration. Contacts, rated at 3 amperes, are excellent for low-level circuit operations. Send for Design Manual 203.

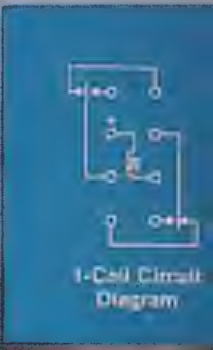


TYPE LF

relay shown (cover removed) is the 2-coil design which controls the entire latching operation within the relay. Shown twice actual size.



2-Coil Circuit Diagram



1-Coil Circuit Diagram

PHYSICAL FEATURES

Life Expectancy
Wet Circuit:
3.0 amperes, 28VDC resistive—100,000 operations
2.0 amperes, 28VDC resistive—250,000 operations
1.0 ampere, 28VDC resistive—1,000,000 operations
1.0 ampere, 28VDC inductive (100 millihenry)—100,000 operations
1.0 ampere, 115 VAC resistive—100,000 operations
Dry Circuit:
1,000,000 miss free operations when subject to conventional dry circuit requirements.

Temperature—+125° C to −65° C

Shock—100g's for 1/2 sine wave 11 ± 1 MS pulse

Linear Acceleration—100g's minimum

Vibration—.250″ DA or 30 g's, 5-2000 cps.

Humidity & Salt Spray—MIL-R-5757D

Enclosures: Tinned brass cover with fungus-resistant finish. Hermetically sealed and filled with dry nitrogen at atmospheric pressure.

Contact Arrangement—2PDT latching

Terminals—Plug-in (3/16″ straight), solder hook, 3″ straight

Wiring—Two coils (as shown on drawing above)
One coil (as shown on drawing above)

Weights—.54 oz. for plug-in
.62 oz. for 2 studs, 3″ leads

ELECTRICAL FEATURES

Operate Time—Two coil: When applying—for a minimum of 5 milliseconds—a voltage of at least two times the must operate voltage, the operate time including bounce will not exceed 5 milliseconds. One Coil: operate time will not exceed 8 milliseconds.

Sensitivity—Two coil, approximately 150 milliwatts
One coil, approximately 75 milliwatts

Dielectric Strength
Sea level: 1000 volts rms—all terminals to case
1000 volts rms—between contact sets
600 volts rms—between open contacts of a set
70,000 ft: 350 volts rms—all terminals to case

Insulation Resistance—1000 megohms minimum at +125° C between any two terminals and between all terminals and case.

Maximum Interelectrode Capacitance—

Closed contacts to case	3.7 picofarads
Open contacts to case	2.0 picofarads
Between contacts of a set	2.0 picofarads
Between adjacent contact sets	3.5 picofarads

Maximum Coil Dissipation
Two Coil: .50 watts at +125° C
.75 watts at +25° C
One Coil: 1.25 watts at +125° C
2.0 watts at +25° C

Standard Adjustment—Relay will operate and hold when the must operate voltage is applied

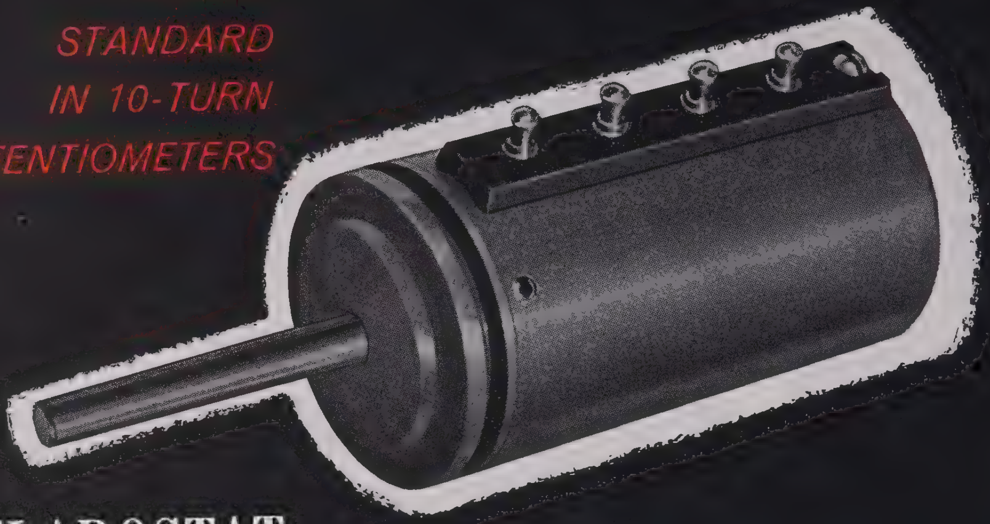
Contact Resistance:
Maximum: 50 milliohms at 6 volts, 100 milliamperes.
Typical: 25 milliohms at 6 volts, 100 milliamperes.

For coil and mounting data on CLARE Type LF relay send for CPC-12. Address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 19, Ontario. Cable Address: CLARELAY.

C. P. CLARE & CO. *Relays and related control components*

Circle 60 on Inquiry Card

A NEW
STANDARD
IN 10-TURN
POTENTIOMETERS



CLAROSTAT

SERIES 59M14

A new high in potentiometer capabilities . . . the Clarostat Series 59M14, 10-turn, ⅞" potentiometer packs more performance per cubic inch than any other multi-turn pot today. Clarostat's unique design permits more winding length in a given diameter than conventional designs. And, price-wise, the Series 59M14 is competitive across-the-board.

For all your multi-turn potentiometer needs, compare Clarostat for quality, for value . . .

SPECIFICATIONS — SERIES 59M14, 10-TURN POTENTIOMETERS

• Diameter	⅞"
• Length	1.55" (Bushing) 1.611 (Servo)
• Maximum Resistance	100,000 ohms
• Indep. Linearity	± .25%, To ± .05%
• Wattage	4.5 watts @ 40°C.
• Taps	Center tap
• Rotations	$3600^{+10^\circ}_{-0}$
• Maximum Torque	1.0 oz. in.
• Weight	1.0 oz.

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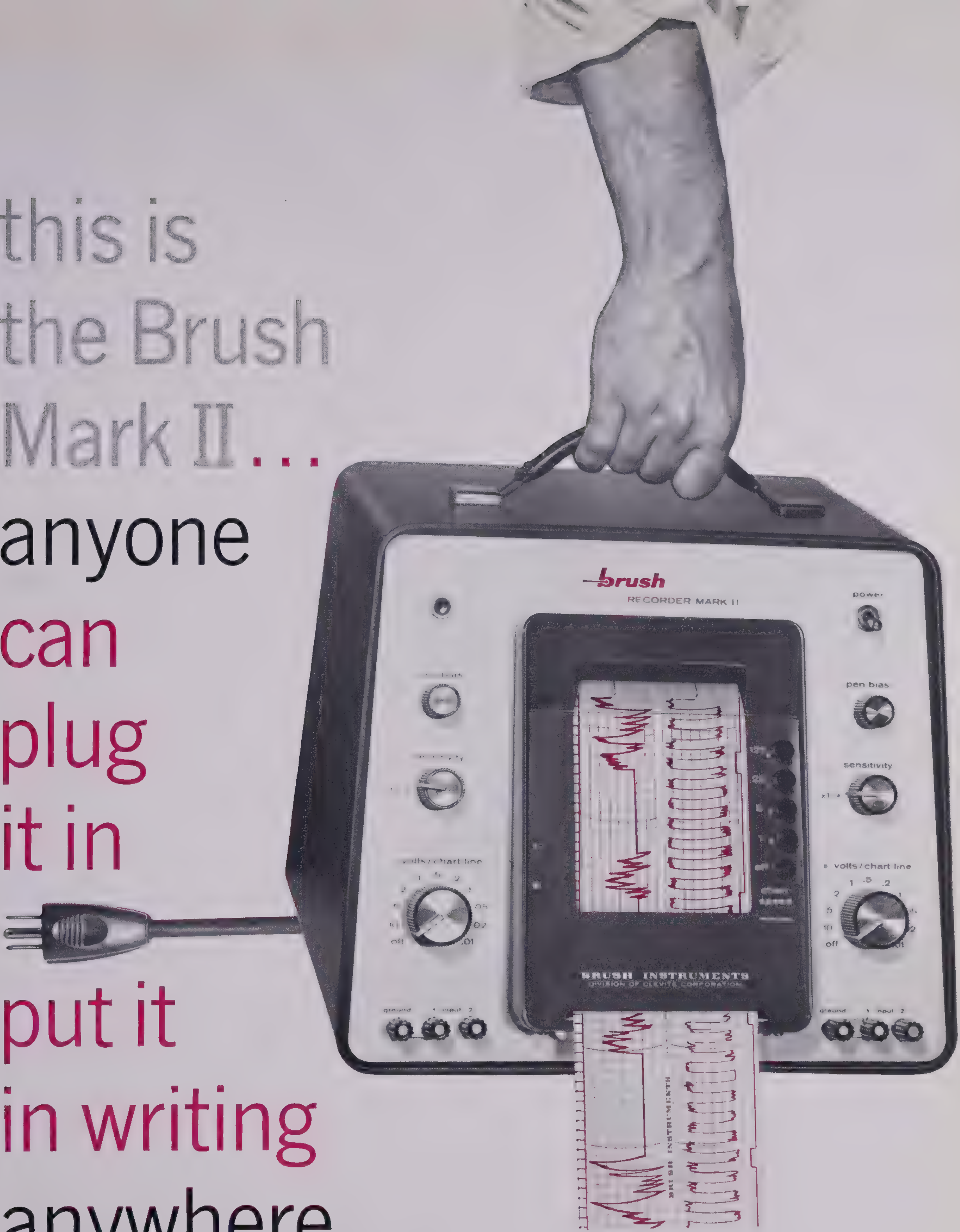

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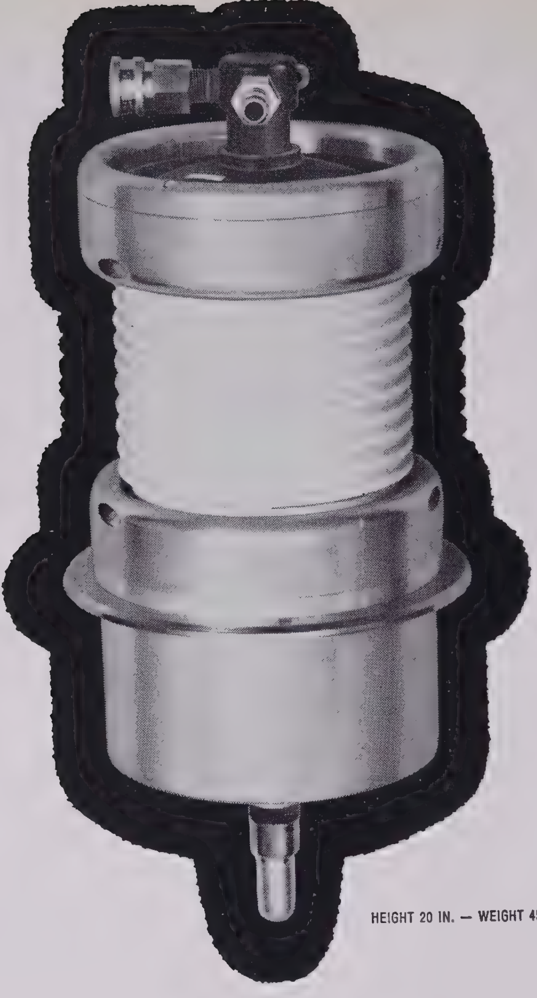

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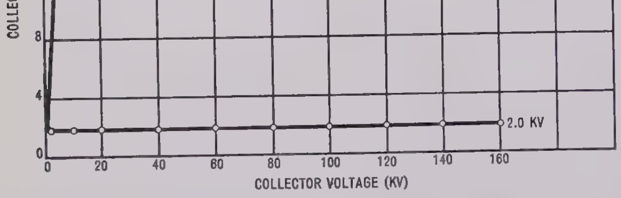

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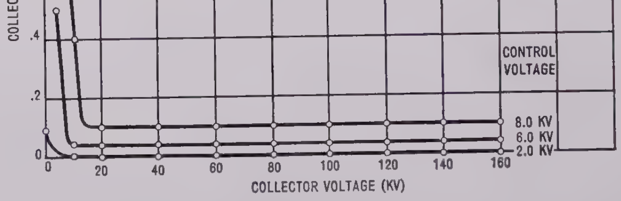

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THIN-FILM TECHNOLOGY

The applications of thin-film depositions have led to a new field in the design of many electronic components. The article deals with the most recent techniques in vapor deposition, sputtering and electro-plating methods. A survey of the new application of materials is described in such uses as design of resistors, and capacitors in vapor depositions. Magnetized thin-film memory devices are discussed, and the aspects of modular construction. Many charts, tables and diagrams are used to illustrate the text.

HOW TO ANALYZE FEEDBACK IN TRANSISTOR AMPLIFIERS

The performance of multi-loop feedback amplifiers can be improved using positive feedback. Harmonic distortion and sensitivity to parameter variations can be reduced, signal-to-noise ratio can be increased, an imput and output impedance can be made either high or low. Using positive feedback in general results in a conditionally stable amplifier. A thorough analysis is needed to insure stable operation with adequate phase and gain margins.

COUNTERMEASURES CARD FILE SYSTEM

In the battle between Electronic Countermeasures (ECM) and Counter-countermeasures (CCM) the demand for current useable information is pressing. The card file system discussed in this article works for a large corporation. It may be adapted to any other tech data file.

FOURIER ANALYZER USES THE HALL EFFECT

A system which can determine both the magnitude and phase angles of the Fourier components of a periodic signal is described. The system uses three basic operations: phase shift, multiplication, and averaging. An active tuned circuit provides the phase shift. A semiconductor Hall effect device is used for multiplication and averaging. Magnitudes with the wave analyzer agree within 10%, and phase angles as compared with calculated values agree within 5% for 11 out of 20 harmonics.

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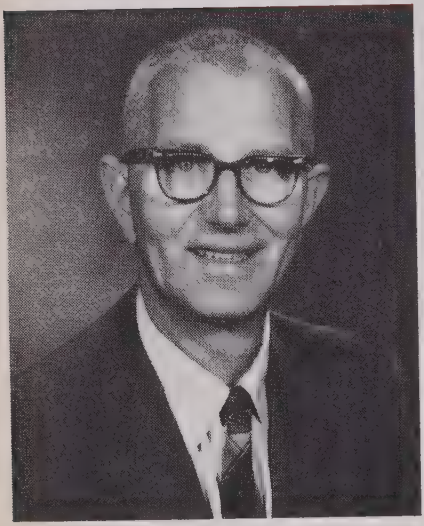


Dr. LESLIE W. BALL
Director of Reliability
Aero Space Div.
Boeing Airplane Co.

Reliability Disciplines—The Price of Electronic Industry Responsibility

INDUSTRIES, like people, must pass from the lusty freedom of adolescence into the sober responsibilities of adulthood.

During its colorful adolescence, the electronics industry forsook some of the technical and management disciplines that had become essential factors in the management of the older segments of engineering. This deviation was acceptable at the time because the products of the electronic industry were used primarily for entertainment, or to add convenience to the systems where their failures were covered by redundant non-electronic equipments. The early autopilot manual control redundancy on an aircraft was typical of the limited dependence of the customer on the electronic product.

Today there are many systems in which, if the electronics fails, the result is not the take-over of an alternative equipment, but complete disaster. The major defense systems of the United States are moving into this class. If, in the immediate future, we fail to do a better job of restoring neglected disciplines, then replacement of obsolescent equipment with highly automated, high performance, low reliability systems can become a national catastrophe.

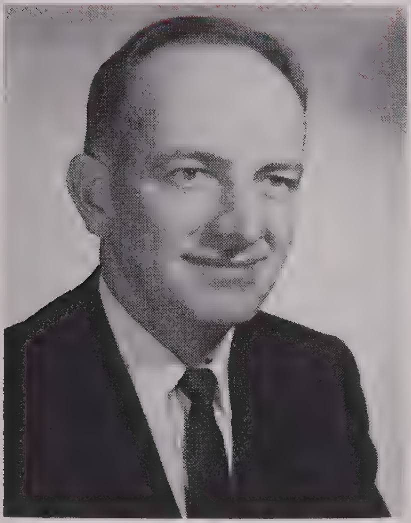
What are these disciplines and how well does the industry know what needs to be done to prevent disaster from their neglect? What is required is not anything really new, but rather reversal of slippage of self-discipline and reversal of growth of paternalism. Reliability achievement requires that management at all levels, from resistor manufacturer to systems assembly and test contractor, be firm in its insistence on an effective system of "Failure Experience Retention." This means that a substantial fraction of equipment failures must be subjected to exhaustive analyses in terms of what management can do to introduce or strengthen disciplines that will reduce the probability of recurrence.

Analysis of the physical phenomena of the failure process and communication of this information is only one aspect of Failure Experience Retention. Some failures do occur because of ignorance of physical phenomena, but most are caused by deficiencies in the self-discipline of design, manufacturing, quality control, installation, maintenance and operating personnel. It is the inescapable responsibility of the employers of these personnel to find means of controlling their employees so as to achieve the reliability commitments in their contracts.

With all the romance and paternalism that pervades the industry today, management may shy away from such a straight-forward term as "employee control" and demand some such phrase as "guiding and motivating associates to recognize and follow the appropriate self-disciplines." Whether we manage by direct responsible leadership, or whether we prefer gently applied psychology, the result must be that employees understand that their future, as well as that of the customer, depends on conscientious application of all those disciplines that failure analysis has shown to be essential.

Let us illustrate by the classical case of electronics stress analysis. The tradition of reputable structural design departments is that the stress and strength for each mode of failure of each part must be calculated, demonstrated by testing and signed off as adequate by the supervisor and by a specialist independent of the designer. The corresponding discipline in electronics design is that the stress (voltage, power dissipation, temperature) and strength (manufacturers' ratings) and safety margin (per cent derating) of every part must be calculated, demonstrated by testing, and signed off by the supervisor, and by an independent specialist. The challenging questions are, "To what extent is the management of the electronic industry today demanding this sort of discipline, and to what extent are the representatives of those customers, who must have reliable equipment, showing the courage required to reduce the number of projects and bring realism into schedules so that for each remaining project there will be time and money for the industry to apply even those disciplines that it is already motivated to follow?"

On the answer to these questions depends the issue of whether the electronics industry produces a solid national defense and a soundly automated industrial resource, or whether we produce a supermarket stacked with gaudy junk.



Component Price Cutting Defeats Reliability

Dr. HARPER Q. NORTH
President
Pacific Semiconductors, Inc.

COMPONENTS such as semiconductor devices are inherently capable of exceedingly high reliability. Accelerated life tests have indicated that failure rates can be reduced below one unit in five hundred thousand per thousand hours of operation. And yet, in spite of the fact that the failure of a diode or transistor can lead to the destruction of a multi-million dollar missile or satellite, "reliability" is in danger of becoming a buzz word subject only to lip service. This shocking fact can be attributed to several shortcomings in our military and industrial complex.

Highly competitive bidding for major military contracts has led to vanishingly small, if not negative, profit margins. Frequently, an agency awarding a contract is required to accept the lowest bid from anyone selected from a list of "qualified vendors." The agency is not in a position to monitor reliability adequately, for it cannot readily be written into the specifications of a system. The system manufacturer expecting to enjoy at least a meager profit is forced into buying components which he hopes are adequate. Buyers in his organization are besieged by hungry component manufacturers, particularly in the chaotic semiconductor business, and they are unable to assess the fantastic claims of the salesmen who besiege them. Their basic training, to buy at the lowest price from a reputable vendor, is their only guide. The result of this sequence, too late, is today's needlessly high failure rate in complex systems whose loss in total costs U. S. tax-payers billions of dollars and threatens the success of vital defense programs. The cost of reliable components is negligible compared to this staggering loss.

Component manufacturers, particularly in the semiconductor industry where profits have vanished and inventories are being unloaded, are wondering if there is a place for an ethical and reputable manufacturer who asks only a fair price for the quality and reliability required in military systems. To assure reliability, particularly in semiconductor devices, someone must bear the cost. Device manufacturers have assumed tremendous financial risks in the belief that the government and systems manufacturers expect the quality specified in their purchase orders. Someone must see that they are getting it, or they won't. Bona fide tests must be conducted by the component or system manufacturer or both, and data must be available to substantiate the results of the tests. It must be recognized that such tests are expensive but that they are well worth the price in terms of failure rate of complex military systems.

Specifications for reliability must be realistic. It is clear that not every system requires, nor should its manufacturer pay for, highest reliability. He should merely see to it that he is getting what he needs, and he must be willing to pay a fair price for goods received. Billions of dollars and months to years of time may be lost if the current trend toward "getting by" is not halted.

There are a few encouraging signs on the horizon concerning reliability programs. Testing of components for Minuteman and Nike-Zeus are examples worth noting. Industry committees on reliability such as those of JEDEC and AIA are steps in the right direction. The PMSR-1 (Parts Specification Management for Reliability) program of the Department of Defense should have the most widespread effects. It requires the continual monitoring of a manufacturer's components as a replacement for the once prevalent practice of qualifying the manufacturer once and forgetting his performance thereafter; and the program requires that failure rate be firmly written into a product's specification. But even this program is meeting with resistance among component manufacturers who are unwilling, perhaps for good reason, to invest in expensive equipment required to demonstrate product reliability. They have no assurance that anyone is really willing to pay for that reliability rather than taking the low bid and the word of an enthusiastic salesman.

The problem can only be solved when the government or system manufacturer is willing to pay the price or to give the component manufacturer sufficient assurance of their sincerity to justify the great financial risk involved.

OWEN S. OLDS
Vice-President
Ryan Electronics
Ryan Aeronautical Co.

Use of our Technical Resources in Relation to Our National Security

ONE of our Nation's most difficult and vital tasks is to maintain adequate deterrent against total warfare while being prepared for potential limited war and holding a strong, progressive position in the race for preeminence in space. All this must be achieved within a reasonable budget and without sacrificing the basic element of our chosen way of life. To accomplish these necessities of survival, it is essential that we direct and use our technical resources with high efficiency and clearness of purpose.

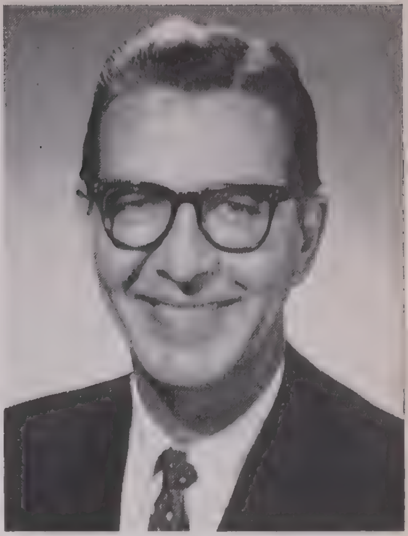
In many respects we are not presently using our technical resources in an efficient and sensible manner. This dangerous situation can have such obvious catastrophic consequences that means toward rapid corrective action should be found on a crash basis. Clearly, close cooperative action between Government agencies and private industry is essential to achieve the desired end results.

There are numerous probable causes for the present misuse of our technical resources. In general, it appears that the roots of the difficulty are due to the fact that many of our present techniques for achieving our national security objectives are insufficient and antiquated in relation to the tremendous tasks before us. The rapid progress that must be made in the presence of the basic problems yet to be solved, in almost all areas concerning our national security and world stature, is staggering indeed. New techniques for the accomplishment of our security programs must be borne from a widespread, thorough, and realistic understanding of the job to be done.

Another basic cause of inefficiency in the use of our technical strength is the great change in the basic nature of our security programs. It is noted that in 1950 the expenditures for research and development by the Department of Defense alone totaled approximately $245 million, whereas in 1960 this figure rose to $4.2 billion and will be much higher this year. Concurrent with this great increase in the research and development funding there has been a substantial drop in production requirements, as represented by the decrease in the number of aerospace production workers from 541,000 in 1954 to approximately 367,000 at present. This shift in emphasis from production to research and development has had a dramatic effect on industry. Reorganizations, mergers, team arrangements, and drastic changes

(*Continued on page* 204)

Dr. REX C. MACK
Assoc. Mgr., Advanced Projects Lab.
Hughes Aircraft Co.



Needed—A Tactical Advantage

THE electronic industry has contributed significantly to U. S. progress in the conquest of space. What about the other races and battles which sum up to the overall combat in which ideology is at stake? Can the industry help to provide a greater capability to effectively cope with these battles in which we are definitely engaged?

Some 16 years ago the atom bomb was dropped on Hiroshima. This event ushered in an era during which our national war strategy has undergone radical and almost continual change—an era, in fact, during which our entire way of life has been significantly influenced. First, the possessor of nuclear weapons maintained a tremendous advantage over any adversary. In fact, a single possessor could undoubtedly assume an international dictatorial role.

Soon, however, other nations developed similar weapons, and in a surprisingly short period of time thereafter there was, so to speak, nuclear parity. Both East and West maintained such vast destructive capability that neither side would dare attack the other for fear of being hit back with like devastation. Such thinking led to the philosophy of deterrence, and then graduated deterrence. The conclusion is simple and straightforward. The very existence of nuclear weapons will maintain a reliable balance of terror—there will be no more global wars, barring accidents.

Without a major war how is the aggressor to achieve his objective? He must accomplish his over-all objective by successfully summing up a number of limited objectives. This forces the likelihood of other kinds of wars—technological wars, economic wars, propaganda wars, and the local or tactical war.

The technological war is being raged in space, tactical (localized, smaller scale military operations) outbreaks are steadily on the increase—Cuba, Laos and others, newspapers are full of propaganda of one sort or another, and when all of this is added together the economic war is evident. It is so terribly important that we realize that these are wars—to realize the importance of the emergency created by conflicts on all fronts regardless of the form.

There can be no doubt that the Russians have made great progress on all fronts and there can be no doubt with regard to their intentions for the future. Through victories on all fronts—political, economic, technological, and local wars—the communists intend to dominate the world. They are working hard to achieve victories, they have grim determination, and they intend to win.

What has been our reaction? Many of us are far too complacent; many don't care whether the Russians are in South America, Africa and S.E. Asia or if they beat us to the moon. But this is a war and there are only two possible alternatives—victory or defeat—a defeat which, in this case, is tantamount to disaster. We must meet the challenge, for the communists are slowly but surely building a big ball of yarn by tying together small bits and pieces. If we don't stop them the ball of yarn will become the globe, a situation which is frightening to contemplate.

Recent announcements by President Kennedy indicate a complete awareness of the situation discussed above. He has asked for more funds for the space race, increased emphasis on our capability to win limited wars, and continued strong effort in developing our deterrent forces. It can be assumed, however, that the electronic industry is not aware of the same fundamental facts. The industry is meeting the challenge of space, it has materially contributed to the success of the ballistic missile, and it continues to make major contributions to our over-all progress in science and engineering. So far as limited war, however, there has been very little of either talk or action. With some intelligent thought, some constructive conversation, and some action pointed in the right direction, we can achieve some progress toward solutions and can expect government support for programs where it is warranted.

Where do we go from here and, in particular, what can the electronic industries contribute to the ultimate success of our fight to maintain the existence of our ideology and, in fact, the existence of our country itself? First, we must develop an awareness of the true nature and the seriousness of our predicament. Admit, in fact, that we are engaged in a war that we must win. We must achieve victory in the race in space; we must maintain economic superiority; we must develop means to win localized wars; and we must continue to deter global war. When we have fully realized these all important, fundamental facts, required action becomes self evident. From a practical standpoint, the contribution the electronic industry can best

(Continued on page 198)

An Evaluation

CATHODE-RAY tubes all use certain basic functions for producing visual displays. Briefly stated they are: a source of electrons; a lens system, which is used to shape the electrons into a fine beam; a method of deflecting, or positioning the beam; and a fluorescent screen to display the beam.

Of these functions, the beam deflection is the most significant from a scientific viewpoint, and is the main study of this discussion. To clarify the main theme, a brief description of the operational functions of the other electrodes is desirable.

Nearly all conventional cathode-ray tubes now use *tetrode electron guns* to form a shaped beam of electrons. These guns have many advantages over the triode gun in reducing space-charge error, producing a narrower beam, and permitting less critical mechanical alignment of the gun structure.[1] Of equal importance is the reduction of interaction between the focus and intensity controls, and the ability to use the screen grid tetrode in high-voltage electron guns. Cathode-ray tubes used in oscilloscopes are generally operated at cutoff during the periods of retrace and in the absence of signal to the vertical deflection system. Illumination is easily accomplished by intensity modulation of the beam with a positive or negative intensifier pulse or gate at the control grid or cathode, respectively.

Typical *spot sizes* run from a minimum (in commercial models) of 2 to 5 mils, to a maximum of 30 mils, depending on the application. Experimental image-intensifier and other tubes are known to have spot widths in some cases less than 10^{-3} mil. However, for cathode-ray-tube applications these fine beams contain too low a current to excite present-day screen phosphors sufficiently at high writing speeds. At small spot sizes and high writing speeds it is necessary to use beam potentials in the 15 to 25 kv range.

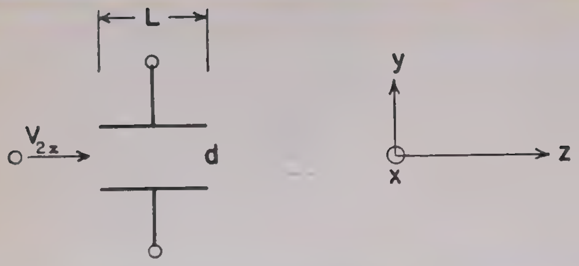


Fig. 1: Parallel-plate deflectors.

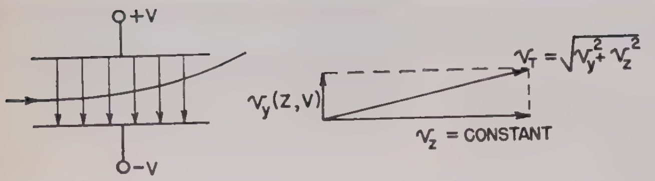


Fig. 2: Velocity components inside parallel-plate electrodes.

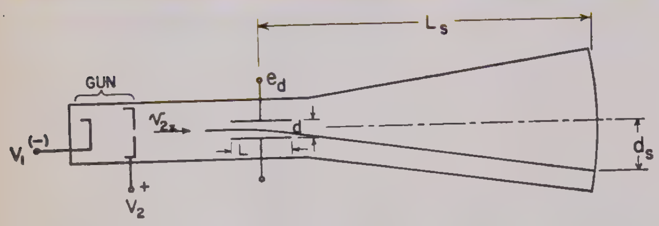


Fig. 3: Typical cathode-ray tube.

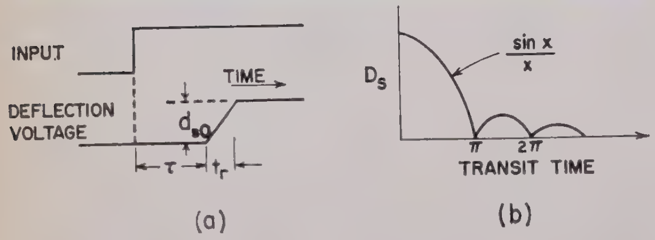


Fig. 4: Transit-time effects in conventional cathode-ray tube; (a) distortion of step-voltage input; (b) deflection voltage.

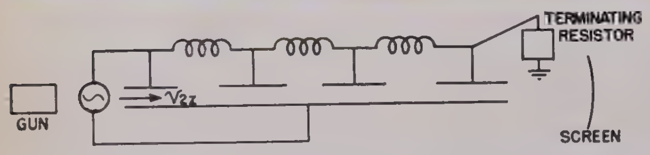


Fig. 5: Pierce-type traveling-wave deflection system.

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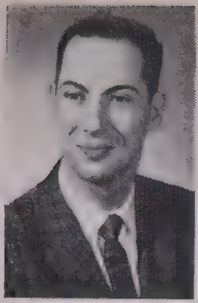
D. R. Noel

Chas. Susskind

By DONALD R. NOEL
Research Engineer
and CHARLES SUSSKIND
Associate Professor
University of California
Berkeley, Calif.

# of Kilomegacycle Oscilloscopes

The only effective device for viewing non-recurring events at high frequencies is the traveling-wave oscilloscope. The newer sampling devices used for frequencies of 1 KMC are compared in display techniques, and evaluated against TW 'scopes.

CRT *screens* differ appreciably with individual tube applications. Of special interest are the decay times, resolution, and spectral bandwidth of visible light of the traces. A tube designed primarily for viewing nonrepetitive transients would necessarily use a long-persistence phosphor and an illumination spectrum that could be readily photographed. One oscilloscope (Model KR-3B, made by EG&G, Boston, Mass.) used for recording single-shot transients specifies a 2-mil spot diameter (at an unspecified current) and relatively small spot scan. Hence, a high-quality high-resolution phosphor is used.[2] In general oscillographic work long persistence is sometimes undesirable and unnecessary. Therefore, illumination is chosen that is pleasing to the eye, that photographs easily, and that fulfills the needs of the customer. More than 25 standard phosphors are commercially available for use, not to speak of still experimental transparent and other phosphors.

Limitations of Deflection Systems

A standard scheme used to deflect the electron beam of a CRT comprises a system of two sets of parallel-plate electrodes, one mounted for horizontal deflection and the other for vertical deflection. The beam is accelerated in the gun system and leaves the gun with a velocity that remains constant as the beam travels through the deflection region.

The motion of an electron beam through a pair of deflection plates (Fig. 1) is described by the equations of motion $F = qE \doteq ma = m(d^2y/dt^2)$, where q is the particle charge, E, is the electric field density, m is the particle mass, and a is the particle acceleration. Then $d^2y/dt^2 = -(q/m)(\text{grad } e_d)$, where e_d is the deflection voltage that produces an electric field E in the y plane. Fringe effects are generally considered to be negligible. Successive integrations yield, for constant E,

$$a_y = -qe_d/md$$

$$v_y = \frac{-qe_d}{md}t$$

$$y = \frac{-qe_d}{md}t^2$$

It can be seen that the path followed by the electron beam inside the parallel deflection plates is parabolic. The entrance velocity v_z of the beam is obtained from

$$\frac{1}{2}m\left[v_{2z}^2 - v_{1z}^2\right] = \int_{P_1}^{P_2} \mathbf{F} \cdot \mathbf{dz} = -q\int_{P_1}^{P_2} \mathbf{E} \cdot \mathbf{dz} = -q(V_2 - V_1)$$

or

$$\frac{1}{2}m\,v_{2z}^2 = -q(V_2 - V_1)$$

where v_1 is the initial velocity at the cathode and is generally insignificant, V_1 is the cathode potential, and V_2 is the final anode potential. Hence the beam velocity is $v_2 = 2\eta(V_2 - V_1)$, where $\eta = q/m$.

The total velocity in the deflection region is therefore, a function of position and other parameters; it is given by $v_T = \sqrt{v_y^2 + v_z^2}$ (Fig. 2). The time of an electron transit through a set of plates is $t_d = L/v_z$.

To take advantage of the faster electron motion, deflection plates are nowadays flared so as to make the beam as nearly perpendicular to the electric field as possible and so obtain an enhanced deflection sensitivity. This modification can be employed to particular advantage in cathode-ray tubes utilizing long deflection plates and slow beam velocities; it has the added advantage of utilizing the small separation between the deflection plates at entrance end to improve sensitivity.

(*Continued on following page*)

Kilomegacycle Oscilloscopes

(Continued)

After leaving the deflection plates, the beam travels in a straight line to the screen. The deflection d_s at the screen (Fig. 3) is derived as follows:

$$d_s/L_s = v_y/v_{2z}$$

Substitution of

$$d_s = \frac{L_s q e_d L}{m v_{2z}{}^2 d} = \frac{L_s L e_d}{2d\ (V_2 - V_1)}$$

yields

$$D_s = \frac{d_s}{e_d}\ \frac{L L_s}{2d\ (V_2 - V_1)}$$

where D_s is the deflection sensitivity of the tube, usually given in units of inches or centimeters per volt. In some instances deflection sensibility is used instead, which is a measure of the voltage necessary to deflect the beam one spot width on the face of the cathode-ray tube. Germeshausen et al., derive an equation for optimizing sensibility, and show how it applies to the design of their high-sensibility traveling-wave cathode-ray tube.[3] (Deflection factor, another term sometimes used, is the reciprocal of deflection sensitivity.)

For a cathode-ray tube with deflection plates of the order of 8 cm in length and a beam velocity of 2 kv, the transit time would be about 3.5 x 10^{-9} sec (3.5 ns). Transit-time attenuation and distortion become perceptible when transit through the deflection plates takes up a time of the order of 1/8th of the period or more. Hence, the above tube would have a practical upper bandedge frequency of the order of 36 Mc.

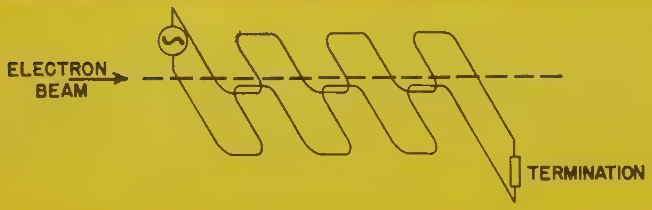

Fig. 6: Owaki traveling-wave deflection system.

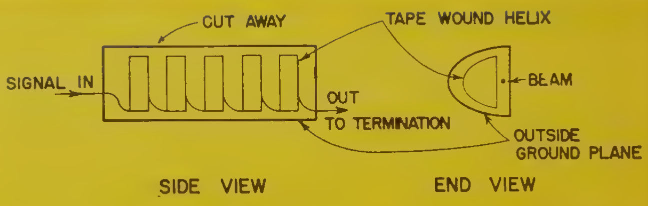

Fig. 7: Smith deflection system.

To achieve a wider frequency response several factors can be varied, but only at the expense of part of the tube performance. If plate length is shortened, or the beam velocity is increased, a loss in deflection sensitivity results. If the plate spacing is decreased, the usable scan shrinks seriously. A new deflection system that would overcome this shortcoming of the simple parallel-plate configuration has been the subject of many investigations, resulting in many solutions.

Until the late 1930's transit time presented few problems: vhf and uhf oscillators were still in the developmental stage owing to vacuum-tube limitations. Since then much emphasis has been given to the display of fast millimicrosecond switching transients, and various methods of adapting the cathode-ray tube to uhf operation have been proposed and used.

The cathode-ray tubes used for general oscilloscope work were still far from requiring a large bandwidth capability, since in most instances the commercial oscilloscopes were, and still are, limited in response to below 30 to 40 Mc by the design of their deflection amplifiers.[4] Only where price is no object and where large signal levels are available can uhf signals or fast transients be displayed on the traveling-wave type of cathode-ray tube.

Limiting Considerations

Pulse-sampling techniques, which essentially convert uhf signals to low-frequency signals capable of being amplified in a conventional oscilloscope, have greatly increased the bandwidths of existing scopes without sacrificing sensitivity; however, they have the inherent disadvantage of only being able to display recurrent signals, as described below.

As mentioned earlier, transit-time limitations pose a major problem with conventional deflection systems. Another limitation can become a problem when leads of finite resistance and inductance react with the capacitance of the deflection systems, or when the impedance of the source combines with the input capacity to produce a time constant that operates to limit the rise time of the deflection system. The following results of the effect of transit time and lead inductance have been summarized from Lewis and Wells.[5]

Lead Inductance Effects:

Step voltage input:

The deflecting voltage is

$$V = V_0 \left[1 - e^{-t/T} \left(\cos \frac{t}{T} + \sin \frac{t}{T}\right)\right]$$

The risetime is $t_r = 2.3\ T$

Sine wave input:

The deflecting voltage is $V_0\ (\omega) = V_0 \left(1 + \frac{\omega^4 T^4}{4}\right)^{-1/2}$

Transit-Time Effects:

Step voltage input (Fig. 4a):

The deflecting voltage is

$$d_s = 0 \qquad t < \tau$$

$$d_s = \frac{V_d\, \epsilon\, L_s}{m v_{2z} d}\ (t - \tau) \qquad \tau < t < (\tau + t_r)$$

$$d_s = \frac{V_d\, e\, L_s}{m v_{2z} d}\ t_r = d_{s0} \qquad t > (\tau + t_r)$$

Sine wave input (Fig. 4b):

$$d_{s0}(\omega) = V_0 \frac{2L_s\epsilon}{\omega v_{2s} dm} \sin \frac{1}{2} \omega t_r$$

$$\frac{d_{s0}(\omega)}{d_{s0}(0)} = \frac{\sin \frac{1}{2} \omega t}{\frac{1}{2} \omega t_r}$$

Over-All Limitations:

Step voltage input:

$$d_s = 0 \qquad t < \tau$$

$$d_s = \frac{V_0 L_s e}{b m v_{2z}} \left[(t - \tau) - T + T e^{-(t-\tau)/T} \cos \frac{t - \tau}{T} \right]$$

$$\tau < t < (\tau + t_r)$$

$$d_s = \frac{V_0 L_s e}{b m v_{2z}}$$

$$\left[t_r + T e^{-(t-\tau)/T} \left\{ \cos \frac{t-\tau}{T} - e^{t_r/T} \cos \frac{(t - \tau - t_r)}{T} \right\} \right]$$

$$t > (\tau + t_r)$$

Sine wave input:

$$\frac{d_{s0}(\omega)}{d_{s0}(0)} = \frac{\sin \frac{1}{2} \omega t_r}{\frac{1}{2} \omega t_r} \left(1 + \frac{1}{4} \omega^4 T^4 \right)^{-1/2}$$

Traveling-wave Deflection Systems

In 1949, Pierce published the results of experiments performed with a traveling-wave type of deflection system.[6] His deflectors consisted of a series of parallel-plate electrodes joined by inductors so as to form a lumped-constant transmission line, with the deflection plates forming the capacitance, as shown in Fig. 5. This system was a major breakthrough in the field of displaying milli-microsecond transients.

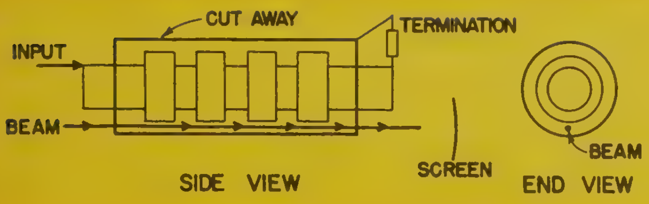

Fig. 8: Lee deflection system.

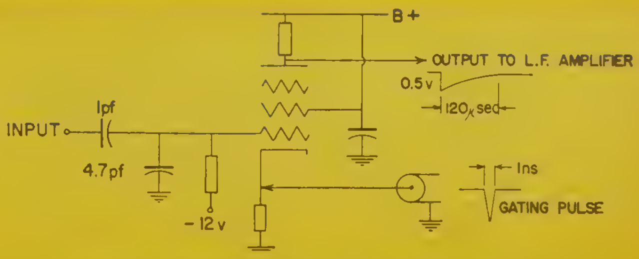

Fig. 9: McQueen pulse sampling system.

Any electron, if synchronized to the group velocity of the delay line, follows the deflecting signal in space and is under the influence of the signal through the entire deflection system. Transit-time limitations in such a tube are for the most part determined by the length of one deflection plate. In 1933, Haeff had used the same deflection system, but for a different purpose; however, this system remained dormant until Pierce found this new application.[7] Likewise, Hollman[8] employed a traveling-wave deflection system in the 1930's and recognized that special plate interconnections must be employed for optimum sensitivity.

Work had been done even before Pierce with micro-oscillography; with particularly high sensibility, even short deflectors yielded usable deflections at high frequencies. The tube described in Pierce's original paper had a spot size of 0.75 mil, required 37 v peak-to-peak to deflect the beam 10 trace widths, and used a 60-power microscope to view the result. The electron gun was located only 3 in. from the screen and the deflection system was quite short, all due to the poor sensitivity of the tube.

Nearly a year later a tube using the same traveling-wave principle was announced by Owaki.[9] In his case, the deflection consisted of parallel wires folded in a zig-zag pattern normal to the direction of the electron beam, as shown in Fig. 6. The tube operated in the kilo-megacycle range, but proved to be less sensitive than Pierce's system.

Smith in 1952 constructed a D-shaped 50-ohm helical delay line placed inside a similarly shaped ground plane.[10] The beam passed between the flat portion of the D and ground plane (Fig. 7).

Lee, using coaxial deflectors with discs machined on the central conductor at intervals, obtained performance to 10 KMC and beyond.[11] Fig. 8 shows how the beam follows longitudinally through the space between the discs and the outer cylinder of the co-ax. Of more practical importance is the system by Germeshausen using a balanced Smith helical-line deflection system.[2] Two helical lines are utilized, with the electron beam traveling between the flattened portions. This is the system used in a traveling-wave oscilloscope manufactured by EG&G.

Moulton designed a system of zig-zag wires parallel deflectors similar to Owaki's by electro-etching a pair of flat sheets.[12]

Although many traveling-wave cathode-ray tubes are available on the market for use as indicators in special systems, the following three oscilloscopes are the only units currently commercially available that use traveling-wave cathode-ray tubes. The type 585 scope made by Tektronix, Inc., Beaverton, Ore., has a balanced Pierce system of parallel deflection plates and a deflection factor of about 5 v/cm (tube rating) which at normal operating potentials uses internal amplifiers that boost the deflection factor to 0.1 v/cm, but limit the bandwidth to 3 db down at 100 MC. The Tektronix type 519 scope uses a system similar to Owaki's zig-zag line but with one solid flared electrode. The scope, which uses no internal amplifiers, is rated less than 3 db down at 1000 MC (including delay-line loss) and has a vertical deflection factor of 10 v/cm, input impedance of 125 ohms, and 4-mil spot width with a wide horizontal scan (2 x 6 cm). The model KR-3B manufactured by EG&G has the following manufacturer's specifications. It is rated 3 db down at 2 KMC and has a sensibility of 0.054 v/tracewidth, sensitivity of 10 v/cm, input impedance

Kilomegacycle Oscilloscopes

(Continued)

of 100 ohms, writing speed of 3 x 10^{11} tracewidths/sec and useful scan of 0.4 in. Good screen phosphor combined with the small 2-mil tracewidth and special camera make this instrument useful for deflection of 4 tracewidths or more.

Grow has described a traveling-wave amplifier so modified as to display milli-microsecond transients within its bandpass.[13] In a traveling-wave tube the electron stream, which is steady in the absence of any signal to the device, becomes "bunched" (velocity and current modulated) with the application of the input signal, proportionally to the amplitude of the input. Grow's tube uses the beam after it has left the interaction area of the tube rather than allowing the beam to strike a dissipative collector electrode. This beam, which is current modulated in the presence of an input signal, is then passed through a transverse magnetic field that rotates it by 90° before it is allowed to strike the fluorescent screen. The radius of curvature is proportional to the velocity modulation of the beam; hence by sweeping the beam horizontally, the tube can be used to display an A-scope presentation of a conventional oscilloscope. Problems in focusing the beam have been solved and signals as low as −45 dbm have been detected with the device. Above 10 KMC, where it may be mechanically difficult to fabricate a traveling-wave deflector, such a band-pass device has the potential of replacing the low-pass traveling-wave systems currently in use.

To view fast transient phenomena rapid writing speeds are necessary, which are difficult to obtain in designing tubes with very small tracewidths. The use of high beam velocities in the deflection area may not be feasible; therefore, postacceleration, or after acceleration is generally used in the region between the deflection system and screen. Originally, a ring, or rings of conductive Auqadag were deposited on the inside of the tube envelope with increasingly higher potentials applied to each.[14] This scheme accelerates the electron beam gradually, causing it to strike the screen with more energy and thus increasing the illumination. However, the potential lumps between adjacent rings create a series of converging electron lenses. Extreme demagnification, and to a lesser degree defocusing, make it difficult to use postaccelerating potentials greater than 3, or 4 times the entrance beam potential.

As early as 1938, Schwartz suggested winding a spiral accelerating electrode of resistive ink on the inside of the glass bulb and placing the postacceleration potential across it.[15] This proposal was largely ignored at the time and was not used until Vollum in 1952 suggested it independently.[16] This technique results in low uniform electric fields of the order of 300 to 400 v/cm directed along the axis, with only small lens effects and almost distortion-free characteristics when compared to the older methods. Nearly all high-voltage cathode-ray tubes used in modern oscilloscopes make use of the spiral-electrode configuration. The EG&G scope has a 1.4-KV beam accelerated to 20 KV by the spiral postaccelerator.

Another method of increasing writing speed is to aluminize the screen. This operation deposits a thin layer of aluminum on the inside of the screen which reflects (toward the viewer) the excited light that would have normally been lost into the tube. This coating also protects the screen from bombardment by negative ions that strike the screen near the center, being too heavy to be influenced by the deflection voltage. The aluminum coating is also necessary as a conducting layer, since at high velocities the electrons penetrate so deeply into the phosphor that secondaries cannot escape; hence, the screen charges to a potential lower than that applied to the lens system and the beam is slowed down, or field uniformity suffers with concomitant aberrations in the display owing to the interaction of stray charges with the electron beam.[17]

Choice of Deflection System

In designing a traveling-wave cathode-ray tube for practical application certain limitations begin to make some systems of deflection more attractive than others.

For instance, if we compromise by using a 2 kv beam in the deflection region it is necessary to observe whether the extra deflection sensitivity, gained by having a relatively slow beam in the deflection area, does not cost too much in writing speed. The 2 kv acceleration sets the beam velocity at 2.65 x 10^9 cm/sec. In a Pierce-type system made up of lumped elements it can be seen that as the frequency of interest is raised, the plate length, and associated inductance must be made smaller to extend the cutoff frequency of the transmission line. Both L and C must change proportionally to maintain a constant line impedance $\sqrt{L/C}$. Eventually it becomes difficult to fabricate, or assemble the added shortened deflection plates with reasonable tolerance; the next step is probably to use a distributed-constant tape helix line as Smith did.[10] Again a geometrical factor (here, tape width) determines how far the bandwidth can be extended. The structure must be designed to have a predetermined characteristic impedances and delay between the deflection actions of successive plates; it seems that as the length of the individual deflector of a distributed system (such as Smith's[10] and Owaki's[9]) is shortened, it becomes difficult to maintain the effective deflection area for electrical and mechanical reasons, so that the deflection factor is lowered. This limitation accounts for the poor deflection factor in Owaki's system. Perhaps, as mentioned above, new techniques such as Grow's modified traveling-wave amplifier[13] will be needed to extend the useful *upper* frequency boundary beyond 20 KMC.

An analysis of higher-order effects in traveling-wave deflection systems, as related to a specific configuration, such as a modified helix, has been carried out by Goldberg.[18]

Sampling Oscillography

A totally different approach to achieve uhf performance in a cathode-ray tube is the technique of pulse sampling. Janssen published the first report on a sampling system of 50-Mc bandwidth.[19] He was followed by McQueen in 1952, who published a report on a 300-Mc sampler.[20] Both Janssen and McQueen sampled by mixing a fast pulse with the input signal and obtained output pulses that were modulated by the input signal. This was a type of synchroscope in which the sampling time base was synchronized with the input signal, causing a smearing of the oscilloscope trace if time jitter, i.e.; recurrence not precisely on time, was present in the input signal. In McQueen's circuit the input tube was held cut off, except when an interrogating or sampling pulse of 1-ns duration was applied to the cathode. The tube would then conduct, and a spike of voltage with an amplitude proportional to the amplitude of the input at the time would appear at the plate and would be sent through the amplifier channel (Fig. 9). The limitations imposed on the bandwidth of this system were caused by the low-pass filter of the input probe lead and the input capacity, and the width of the gating pulse.

A more advanced sampling circuit, currently incorporated in a commercial milli-microsecond oscilloscope manufactured by Lumatron Electronics, Inc., New Hyde Park, N. Y., was introduced in 1952 by Sugarman.[21] The mechanism contains three high-speed devices which, in aggregate, determine the accuracy of the display. The time-delay generator determines the jitter in the displays; the delay cable and sampling probe determine the frequency response. A microwave diode is used as the "gate" within the probe unit. A pulse of 30 mv is applied to the cathode of the gate, which is back-biased "off" until a negative gating pulse is mixed with the signal at the cathode, causing the diode to conduct at a level proportional to the input signal. Maximum modulation of the pulse is limited to 30%. They are subsequently "stretched" to about 0.5 μsec by the input capacitor and are then delivered to an amplifier and the display circuits.

The advantages gained in using a semi-conductor diode gate is that it may be contained in a simple cavity giving it a smooth high-frequency attenuation to prevent "ringing,"* and that it may be switched at low levels (of the order of 100 mv). Each input signal triggers a sawtooth ramp which, in turn, produces a gating pulse at a predetermined level of dc voltage. This level continuously increases with each signal sampling until a given range is swept; then the process is repeated over and over again. The sampling time is increased by raising the level one step at a time. This, called a "staircase" voltage, provides the horizontal positioning voltage for the tube.

The timing circuit is designed to select only the samples from a signal whose area was in a predetermined channel. This circuit eliminates time jitter and area dispersion caused by this dispersion. Waveshape uncertainty is minimized by using trigger circuits that would trigger on the leading edge of the signal where timing uncertainty is least. Figs. 10 and 11 show the significant components of Sugarman's circuit.

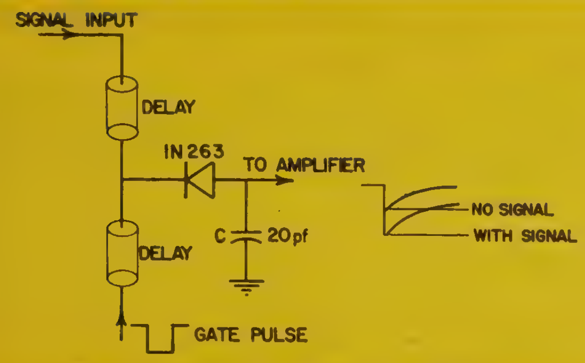

Fig. 10: Sugarman's sampling circuit (input).

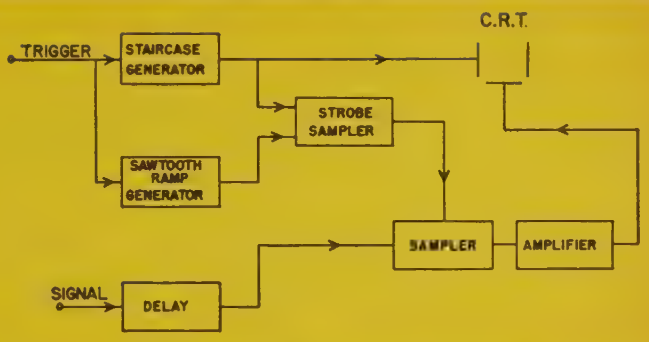

Fig. 11: Block diagram of Sugarman's system.

Two sampling oscilloscopes and one pulse sampling plug-in unit are available commercially at present: the sampling oscilloscope mentioned above (Model 112) manufactured by Lumatron, Inc., New Hyde Park, L. I., N. Y.; the model 185A/187A sampling oscilloscope made by the Hewlett-Packard Co., Palo Alto, Calif.;[22] and the Type "N" sampling plug-in unit by Tektronix, Inc., Beaverton, Ore. All use an adaptation of Sugarman's basic gated-diode sampling circuit but differ in the processing of the signal after sampling.

Sampling vs. Traveling-wave Oscilloscopes

In looking at the sampling units currently available and comparing their advantages and disadvantages with respect to the use of traveling-wave oscilloscopes the following is apparent. Voltages of the order of a millivolt can be viewed on sampling scopes, as compared to much larger minimum voltages on traveling-wave cathode-ray oscilloscopes with very high sensibility. To use a sampling scope the event to be viewed must be recurrent but not necessarily at regular intervals. So long as the recurrence lasts long enough so that a reasonable number of points can be "plotted out" the sampling system will work. On the other hand, the traveling-wave oscilloscope can be used to photograph single-shot transients providing its writing speed is adequate.

Commercial sampling scopes now have an upper 3 db frequency of about 1000 MC, whereas the traveling-wave type tubes are available to 2 KMC. Sampling units can be bought as accessories to conventional oscilloscopes. Such oscilloscopes produce a trace of normal oscilloscope brilliance that can be viewed in normal daylight. Traveling-wave scopes operating at

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*Ringing: high-frequency damped oscillations caused by shock excitation of high-frequency resonances.

Kilomegacycle Oscilloscopes
(Concluded)

low repetition rates must be viewed with the use of light-tight hoods; for single-shot transients viewed at high sweep speeds, it is even necessary to use photographic means to make the trace visible. On the other hand, the sampling scope has a relatively small dynamic range (of the order of 1 v of input voltage) that it can accept without losing linearity or saturating the input circuits. Because of this limitation, high-level inputs must first be applied to an attenuator.

In both cases an external trigger is generally required to initiate the timing of the sampling system or in the case of the traveling-wave scope, the sweep circuits. Finally, sampling scopes are at present capable of substantially larger size of display than traveling-wave scopes, and (inherently) of greater "sweep" speeds.

Acknowledgments

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For Airborne and

Solid

THE 4-layer diode is applicable to fast, relatively high power pulse circuits. They have found recent applications in tracking beacons, portable and weather radar, radar altimeters, and other radar transmitters. They are used for direct pulsing of small magnetrons, grid keying of travelling wave tubes, and triggering of gas tube power switches in high power systems.

In one portable system, battery life was increased from 8 to 24 hrs. by elimination of heater power drain in the pulse modulator. Circuits are operating in military and airborne equipment which can deliver microsecond duration pulses of up to 50 kw peak power, at repetition rates of several thousand pulses per second.

Basic Circuit

The basic pulse-forming circuit using the 4-layer diode is shown in Fig. 1. In operation, the pulse-forming network receives energy through the charging impedance. When a trigger signal is received at the trigger input, the diode switches and transfers part of the stored energy from the pulse-forming network into the load. In this circuit, the diode operates simply as a voltage-triggered switch.

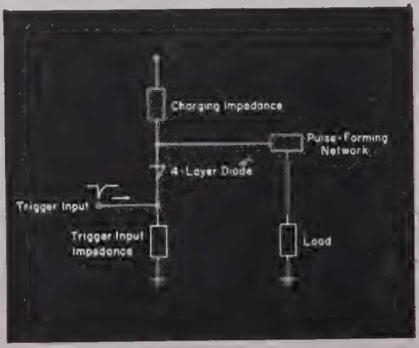
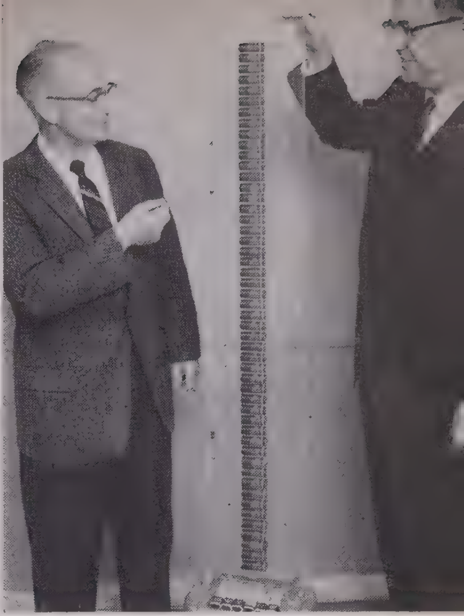


Fig. 1: A basic pulse modulator circuit using 4-layer diodes.



Dr. William Shockley and the author, R. L. Biesele, are looking over an experimental 1 megawatt pulse generator using 4-layer diodes.

By using 4-layer diodes, modulators can be made lighter in weight, and smaller in size, while handling higher peak pulse-power. Circuit design is relatively simple, and tough environmental specs can be achieved.

Portable Applications . . .

State Pulse Modulators

A typical voltage-current characteristic for a 200 v 4-layer diode, as observed on an oscilloscope, is shown in Fig. 2. The diode is an inherently bistable solid circuit, which is either in a high impedance off state, or a low impedance on state. Voltage applied across its terminals in excess of the switching voltage, V_s, will switch the device from the off state to the on state. Once switched, it will remain in the on state so long as the current through the device is above a critical value, referred to as the holding current, I_h. When the current through the device falls below this critical value, the device reverts to the off state. The device is similar in operation to the gas diode or gas thyratron in certain applications.

Breakover voltage in the reverse direction is roughly equal to that in the forward direction (Fig. 2). In this direction, it behaves like a voltage regulator diode, and can be damaged by excessive internal power dissipation. Consequently, the device is normally kept well below this reverse breakover voltage, even for transient conditions.

The 4-layer diode can be triggered on by insertion of a positive-going pulse at its positive terminal. However, this method of trigger insertion results in interactions between the trigger circuit and the pulse circuit. Insertion of a negative-going trigger pulse at the negative terminal of the diode eliminates this interaction and is used, as in Fig. 1. In a practical circuit, a trigger impedance of suitable characteristics must be provided. This is commonly either a conventional rectifier diode, and in some circuits has been a 4-layer diode.

The scope traces of Fig. 3 show the current pulse produced in the load of the basic circuit of Fig. 1, and the voltage at the positive terminal of the single 200 v diode used for switching. The circuit was a simple breadboard. An artificial delay line was used as the pulse forming network.

Noting the current pulse, the turn-on time is about 20 nsec., while turn-off time is of the order of 150 nsec. Switching speeds of this order result chiefly from the design of the 4-layer diode. Both turn-on and turn-off are strongly influenced by the circuit as well as by the device itself. Turn-on is also influenced by the amplitude and rate of rise of the trigger signal. The stronger and sharper the trigger signal, the faster and more uniformly the device turns on.

Practical Circuit Design

A practical pulse modulator circuit is shown in Fig. 4. Three diodes connected in series are used to switch a pulse forming network charged to approximately 600 v, discharging it into a 50 ohm load. A voltage divider network is used to divide the supply voltage equally across the individual diodes in the

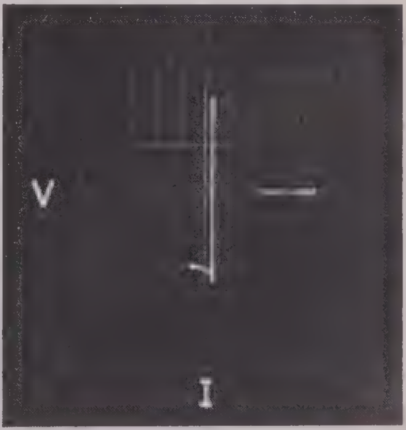


Fig. 2: E-I characteristics of a diode. The scales are 50 v/division; 1 ma/division.

Pulse Modulators *(Continued)*

string. The bottom device is used as the trigger impedance. Power is delivered to the load through a pulse transformer.

Current and voltage traces for this circuit, as a function of time, are shown in Fig. 5. The current pulse shows an amplitude of 6 a, with turn-on time of about 30 nsec., and turn-off time of about 150 nsec. Voltage across the 3 diodes drops to essentially its minimum value in about 50 nsec. The voltage switched is slightly over 600 v. This is possible here because each of the 4-layer diodes used in the breadboard circuit has a switching voltage above 200 v. While it is necessary for the diodes to switch 600 v at 6 a, only 300 v at 6 a, or 1.8 kw, is actually delivered to the load in this circuit.

Data is given in Tables 1 and 2 for two practical pulse modulator circuits which have been incorporated in military systems, as an indication of the current state of the art.

Table 1

Portable Radar Modulator Requirements

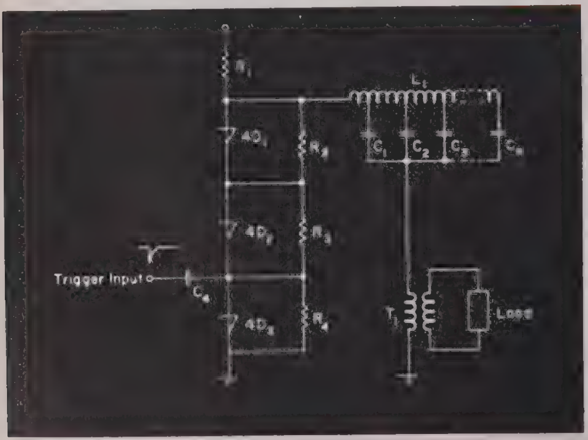
Pulse Duration	0.2 microsecond
Pulse Amplitude	10 amperes
Supply Voltage	500 volts
Repetition Rate	3000 p.p.s.
Load	Magnetron
Peak Power Switched	5 Kilowatts

Table 2

Transponder Modulator Requirements

Pulse Duration	0.75 microsecond
Pulse Amplitude	10 amperes
Supply Voltage	635 volts
Rise Time	0.1 microsecond
Fall Time	0.2 microsecond
Repitition Rate	2000 pulses per second
Maximum Fixed Pulse Delay (System)	0.35 microsecond
Pulse Delay Stability	0.006 microsecond
Load	Magnetron
Peak Power Switched	6.4 Kilowatts

Fig. 4: Schematic of a practical pulse modulator circuit.



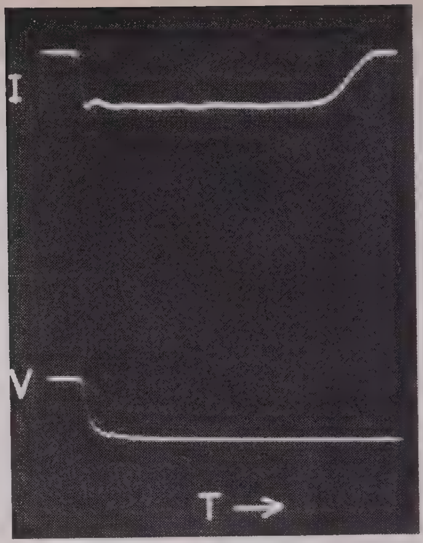


Fig. 3: Scope photograph shows current and voltage transients during pulse discharge in the basic circuit (Fig. 1).

The example in Table 1 is for a portable radar set. It uses 3 Type 4J200 4-layer diodes, without the voltage divider shown in Fig. 4. Substitution of these silicon units for a thyratron switch increased the projected battery life for the set by a factor of three.

The example in Table 2 is for the AN/DPN-63 Transponder. The use of the solid state modulator for this equipment afforded a major reduction in size, weight, and power consumption.

Practical Design Considerations

There are special design considerations which arise in connection with any practical application. Many of these are covered in more or less detail in the published technical data on the 4-layer diodes. Some, however, are peculiar to the pulse-modulator application.

1. *Voltage Rating*

Pulse modulator applications normally use voltages of several hundred volts and higher. Switching voltage ratings of 4-layer diodes are available as high as 200 v. The usual application will require several of the 200 v diodes in series.

a. Bias—The total switching voltage rating of the series string should be at least 10% higher than the voltage of the charged pulse forming network under the most adverse conditions anticipated. This should include the effect of temperature on switching voltage.

b. Temperature—The switching voltage of the diodes decreases as the operating temperature of the junctions increases above 70° C, as shown in Fig. 6. For military design purposes, considered that the switching voltage may decrease as much as 10% at 105° C.

c. Maximum Supply Voltage—Circuits are operating with a supply voltage of 1000 v. Experimental tests show that the supply voltage may be several kv, so long as the voltage is properly divided between diodes in series.

2. *Turn-On*

Several considerations affect the behavior of the devices in the circuit at turn-on.

a. Uniform Turn-On—In operating the 4-layer diode, if the switching voltage is approached slowly, as in a relaxation oscillator circuit, the device will turn on at some point of lowest breakdown, and the design switching voltage may never be fully reached. Under these conditions, all the initial current may be concentrated in a small portion of the active device, with possibly disastrous results as shown in Fig. 7. In most diodes, the current will quickly spread over the entire area of the device, however, either because the voltage drop across the high series resistance of the initial turn-on spot brings other areas of the switching junction to avalanche, or because of minority carrier diffusion.

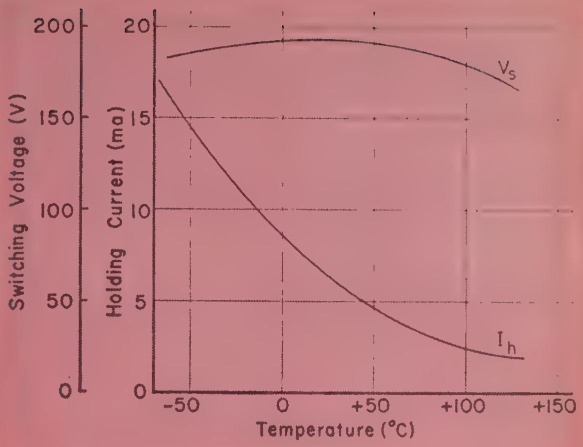


Fig. 6: The graph shows typical switching voltage and holding current change with temperature for 4-layer diode.

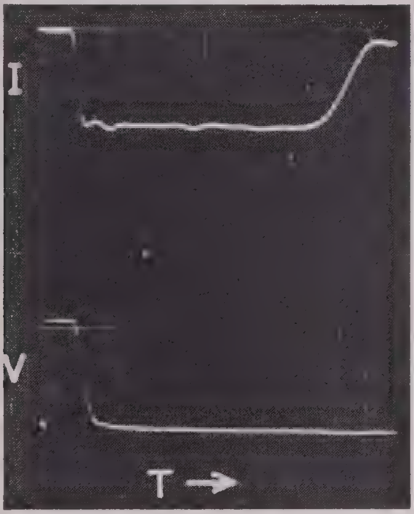


Fig. 5: Photograph shows the current and voltage transients during pulse discharge in the practical circuit (Fig. 4).

If, however, the device is brought up to switching voltage by a fast rising trigger pulse, it is possible to overshoot the avalanche voltage of the lowest spot or spots, and bring the entire junction up to avalanche or switching voltage before a localized spot can turn on. The two sets of turn-on transients (Fig. 8) show that the voltage drop, V_4, across a diode which is pulsed *on*, arrives at its minimum value in a much shorter time than when the diode is permitted to turn itself *on*. The rise time of the current pulse is much shorter for the pulsed-on case, as well. In these curves, V_2 is the voltage drop across a reference diode.

b. Trigger Considerations—The trigger circuit must provide a pulse of sufficient energy to insure positive switching. For a series arrangement, the trigger pulse must be sufficient so that the bias voltage plus trigger voltage applied to one of the diodes is greater than its switching voltage. As this diode switches, it will increase abruptly the voltage appearing across the other 4-layer diodes in series, turning on the entire string.

The trigger pulse should have enough amplitude to drive the triggered diode several volts past its switching voltage under the most adverse conditions of bias voltage and temperature. This will require trigger pulse amplitudes of 20 to 50 v, with pulse duration of 0.2 μsec or longer in practical pulse modulator circuits. For satisfactory pulse delay stability, the trigger pulse should have a rise time of 0.1 μsec or less. A 4-layer diode circuit similar to that of Fig. 1 has suitable characteristics for use as a trigger pulse amplifier, using simply a capacitor in place of the pulse forming network.

c. Rise Time—Once the entire series string starts to switch, the rise time of the current pulse will be quite short. Rise times of 30 nsec. are practical with careful circuit design. The characteristics of the pulse forming network, the output pulse transformer, and the load impedance, as well as distributed circuit constants, may all affect the attainable output pulse rise time.

d. Pulse Delay—Depending on the bias voltage applied to the diodes, and the amplitude and rise time of the trigger pulse, there will be a minor delay between the onset of the trigger pulse and the initiation of the output pulse. In addition, when several diodes are connected in series, there is an additional delay between the time the first diode begins to turn-on, and the time when it turns on the rest of the string. With careful design, this total delay can be held below 0.2 μsec, even for many diodes in the string.

e. Pulse Delay Stability—Variations of trigger pulse rise time, trigger pulse amplitude, or bias voltage will affect the exact time at which the triggered diode actually begins to switch. Time from this point to switching of the entire string will be very constant for the particular set of diodes. Pulse-to-pulse varia-

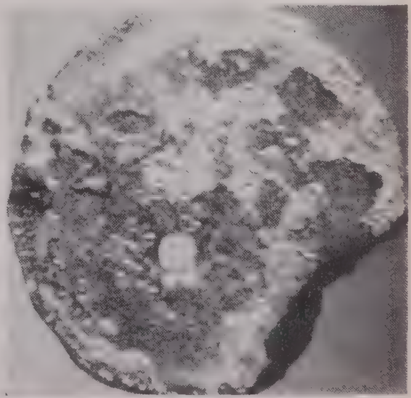


Fig. 7: Magnified view of diode unit shows burnout due to initial current concentration.

Pulse Modulators *(Concluded)*

tion in this latter delay is being held to less than 6 nsec. in the transponder mentioned earlier.

3. *Turn-Off*

In turning off any transistor rapidly, it is necessary to draw the hole or electron carriers out of the base layers of the device. In the case of the 4-layer diode, this carrier extraction can be accomplished by applying a reverse bias of a few volts across the device for a brief time. This is somewhat similar to the reverse bias employed across thyratron modulators during deionization, except that the diode can be turned off in shorter times.

a. Impedance Match—The simplest means of developing the reverse bias required, in pulse modulators, is to make a deliberate but small mismatch between the characteristic impedance of the pulse forming network and the impedance of the load. If the load impedance is slightly the lower, there will be a current overshoot, or current and voltage reversal, at the end of the current pulse.

b. Voltage Regulation—Requirements for voltage regulation of the power supply are not much different for modulators employing diodes than for alternative switching methods. They are important, however, since the overshoot required for rapid turn-off may disappear if the load impedance increases when supply voltage decreases, as is the case with a magnetron tube load.

c. Reverse Breakover—Design of the impedance mismatch must be sufficient, but not too great. Too much reverse voltage can cause reverse breakover of the diode during the turn-off period, causing excessive heating and damage to the device, and in the worst case will cause a catostrophic failure of the diode or the entire switching string. It is desirable to protect the 4-layer diodes in some applications with a parallel circuit. This circuit acts as a bypass for excess current in the reverse direction.

d. Interpulse Period—It has been found, experimentally, that there is an additional period of from 2 to 8 μsec following the small fraction of a microsecond required for carrier extraction in the reverse direction, during which the switching voltage of the devices will be lower than normal. This appears to be the result of a very few residual carriers which have not recombined or been extracted, and determines the minimum period between successive pulses. This interpulse period has been reduced to about 1 μsec in recent experimental devices, so that the prospects for fast pulse trains appear to be promising for the near future.

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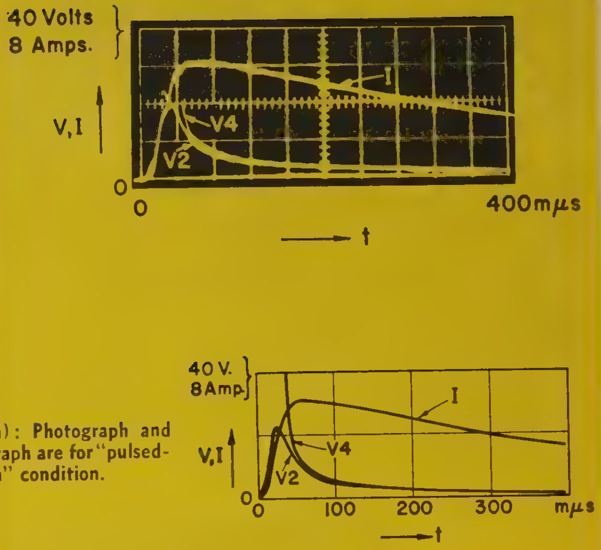
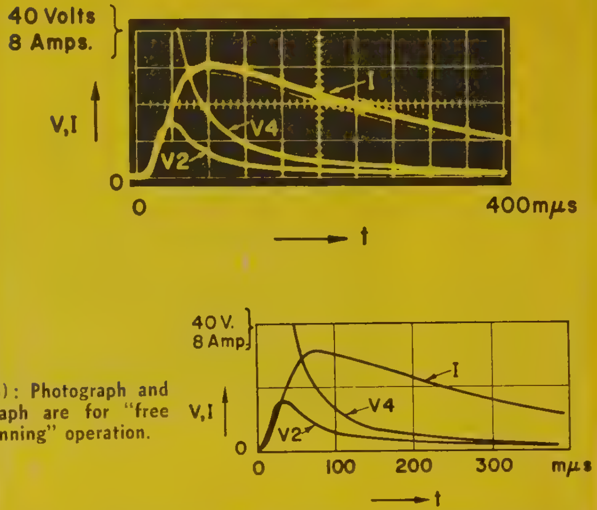


(a): Photograph and graph are for "pulsed-on" condition.



(b): Photograph and graph are for "free running" operation.

Fig. 8. Photographs and drawings of oscilloscope traces show voltage V_4 & V_2 across, and current I through, 4-layer diodes, respectively, having identical resistivity base layers for both (a) pulsed on operation and (b) free running.

Future Possibilities

Most of the pulse modulator applications have employed a 200 v 4-layer diode in a metal pigtail package, rated at 20 a peak pulse current. A glass package diode rated at 10 a peak current is available, and should offer further reductions in size and weight. In addition, a stud mounted metal package having a 75 a peak pulse current has been used recently in circuits switching up to 50 kw peak power.

Indicative of ultimate possibilities, an experimental circuit has recently turned-on pulses in excess of 1 megawatt in less than 80 nsec. It employs 52 4-layer diodes in series, which switch a 10 kv pulse of 100 a peak, with a duration of 3 μsec. The circuit is believed to have switched more power faster than any previous circuit using semiconductor devices. While frankly experimental, it illustrates strikingly the possibilities opened up to the design engineer by the 4-layer diode in circuits requiring microsecond pulses, with peak pulse power ratings up to the megawatt range.

Typical electronic assembly line using the system for step by step operation instructions. This line produces assemblies incorporating 34 different configurations.

Too often we sweep up new techniques and apply them without proper study. Many firms are now ready to adopt the audio-visual method the same way. Here's the full story on its advantages, disadvantages, and capabilities—by an engineer at the firm where it all started.

By WILLIAM A. HARKER
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Audio-Visual Learning— It's More Than Hear-Say!

SPECIFIC INFORMATION to perform any task is traditionally derived from two sources: memory, where knowledge is gained through training and experience; and reference materials such as texts, handbooks, manuals, drawings and other written instructions. In practice this includes the use of classroom training, training and process manuals, on-the-job instruction, and direction from superiors.

Today's scientific-technological world has increased the problem of transmitting accurate, up-to-date information. Too often, human memory has proven unreliable. It demands prolonged learning time and is limited in the amount and complexity of information it can retain. Written matter and verbal instruction embody all of the inherent communications problems, are frequently used improperly and, at best, are subject to misunderstanding and misinterpretation. Manufacture and use of electronics has been limited to well trained and experienced people. This is one of the many problems facing the industry today.

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Bridging the Gap

Fortunately, a solution to this problem has been found in application of the Videosonic* system. Using the two most important learning senses, sight and sound, it bridges the communications gap. Colored slides with a synchronized sound tape as used in the system bring immediate and dramatic advantages. This new medium results in improved classroom training, more readily understood process training and instruction, greatly reduces the amount of direction required from superiors and provides complete on-the-job instruction.

The system was developed seven years ago by Hughes Aircraft Co. It was the outgrowth of a search for a means of communicating complex information to workers in a manner which would permit the best performance of tasks. Since starting many wide and varied applications for this concept have been found.

This audio-visual system consists of both information programming and display equipment. Resembling a portable T.V. set, the unit transmits programmed material through the audio-visual senses. Graphic colored slides are automatically coordinated with a magnetic tape recording to relay information to the worker when needed.

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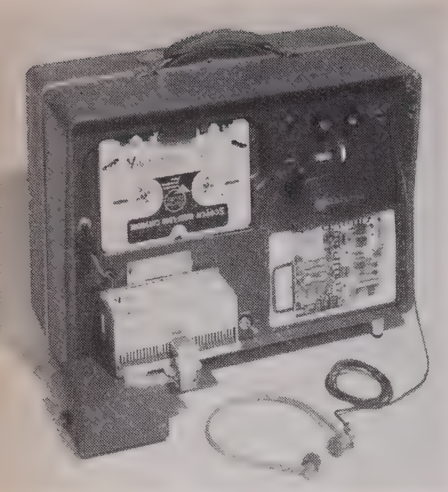
* Trademark of Hughes Aircraft Company.



The functional design provides easy access from the front to all operating controls, slides and sound tape. This unit was designed for assembly type operations.

Audio-Visual *(Continued)*

Two models make it suitable for varied applications. The machine can operate in either of two modes—at the discretion of the individual. It can be run in a continuous uninterrupted manner, or at the flick of a switch, will automatically stop at the end of each instruction or bit of information until reactivated by the user. Though fully automatic, it can be manually overridden by depressing selective push-button controls. The sound system includes a built-in speaker and earphone jacks for optional listening modes. Accessory features include a tape foot counter and a side lens for projection on large opaque screens.

Where the system is used for on-the-job instructions, properly programmed material results in accurate and concise task definition. It shows and tells exactly how each step is to be performed, in sequence, and at the precise moment it is to be done. Thus, the most complex of operations can be easily understood.

Programming

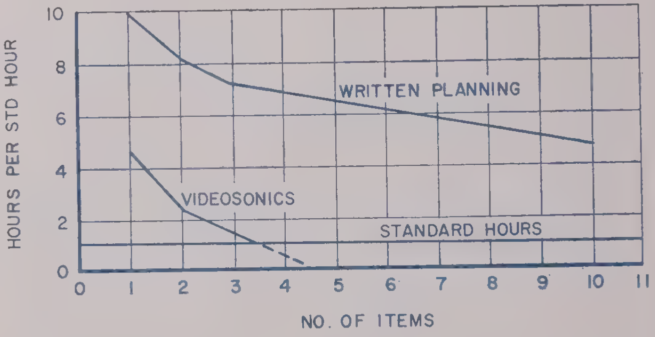
The difference between good and poor task definition lies in the programming of material used. This function is the heart of a successful application. In electronic manufacturing, users of the system have the capability of capturing their top engineering, production, and quality experience for daily recall when it is most needed. Individual workers have this total experience at their finger tips throughout the working day. Conversion of this information to the new medium calls for programming experience. The precision and detail required, plus an understanding of human motivation, places further emphasis on the need for excellence in programming. Among the many factors involved are: gathering pertinent information from proper sources; use of story board techniques in developing basic presentation outlines; requirements for detail *versus* simplicity and proper use of color, artists' aids, props, etc., in preparation of slides; script writing for use in recording the audio portion of the presentation; synchronization of the audio with the visual and editing the total package for greatest impact.

Among the benefits immediately accruing to the user are: reduction of learning time with corresponding increase in productivity; uniformity and standardization of products and methods; improved quality and reliability; increased scope of supervisory activities; increased assurance of meeting time standards in task performance and more practical achievement of process analysis. The experience retention capability of the unit is directly related to and results in increased reliability.

Learning Time

Learning time is practically eliminated. The individual is provided with all the job oriented intelligence required to perform a given task and this intelligence is available for immediate recall whenever needed. The near elimination of learning time results in more rapid increase of an individual's productivity than is obtainable through traditional methods. For example, a new operator, using traditional methods, requires an average of ten times the allowed standard time to produce a first unit. Under the new system, first units can be produced in four and one-half times standard; third units at standard rate. Normally, this rate would not be achieved until the tenth unit. Immediate increases in productivity of 70% are not unusual.

Uniformity and standardization of products and methods, an important element in electronic assembly, are readily achieved.



The system drastically reduces learning time. Note the allowed standard hours to produce a unit are attained much sooner than through the traditional planning techniques employed by manufacturers.

Perhaps the most striking results are improved quality and reliability in workmanship and products. For instance, on jobs where an average of five and one-half quality defects per unit had been experienced, a reduction to one-half defect per unit was achieved upon introduction of the system.

The scope of supervisory activity is increased where the program is used. Supervision is freed of the need for time consuming operator instruction. Now, it can devote more effort to the managerial responsibilities of its assigned functions.

Since Videosonic removes all guesswork and decision making from the job at the operator level, it provides greater assurance of meeting time standards. While the pacing action usually associated with moving conveyors is not claimed for the system, it does achieve a similar result. It encourages methodical and rhythmic operator performance. At the same time, the operator can, by pressing a button, stop the machine at any time in the event of unforeseen trouble such as dropped tools, a part that does not fit properly, or for personal reasons.

In process analysis, the system can be used in much the same manner as micro-motion studies with the added advantage of recorded discussion on what is taking place. A troublesome process can be captured in detail on slides and sound for later study and analysis in a quiet area away from the noise and confusion where the process is normally performed. This permits fullest attention to and concentration on the actual problem. Recorded interviews with the individuals involved further enhance this method of analysis.

Reliability

Reliability can be designed into a product. Maintaining uniform and acceptable reliability during the manufacturing process and later at the point of use is another matter. The solution to this is accurate retention of experience from design through manufacturing, final test and end use. No completely adequate method of accomplishing this had been found until audio-visual methods opened the door. Now there is a way of capturing such experience and retaining it in irrefutable form for recall when, where, and as often as needed. Too often, reliability is retained throughout the manufacturing cycle only to be negated at the hands of an inept user. When equipment fails in the field, the first inclination of the customer is to blame the supplier—although the real trouble may lie in improper installation or the employment of inadequate operating procedures. By completing the loop and providing the customer with audio-visual programs covering installation and operation of complex electronic equipment, the supplier can assure himself of continuing reliability of his product in the field.

There are many applications where such audio-visual systems can be used advantageously. Among them are: new employee orientation, employee training, office systems and procedures, preparation for operation, manufacturing, inspection, testing and check out, instrument calibration, operating procedures, maintenance, and trouble shooting.

Alignment of Frescan 3-D radar data console is quick and accurate despite individual abilities of operators when the system is used.

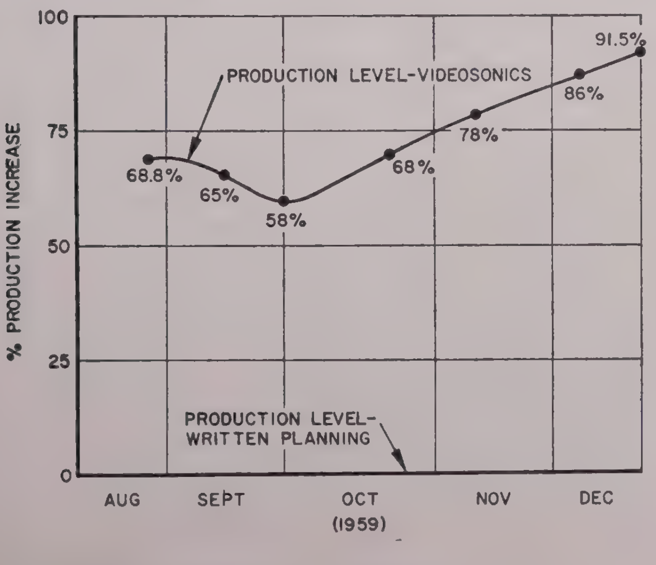
A word of caution, however. The system is not a Pandora's Box; it is not the panacea for all problems, but used properly and with judgment it will bring about results never before attainable.

Inexperience in using this system can lead to trouble and disappointment. It is far better to call on the assistance of experienced people for help in getting a program under way.

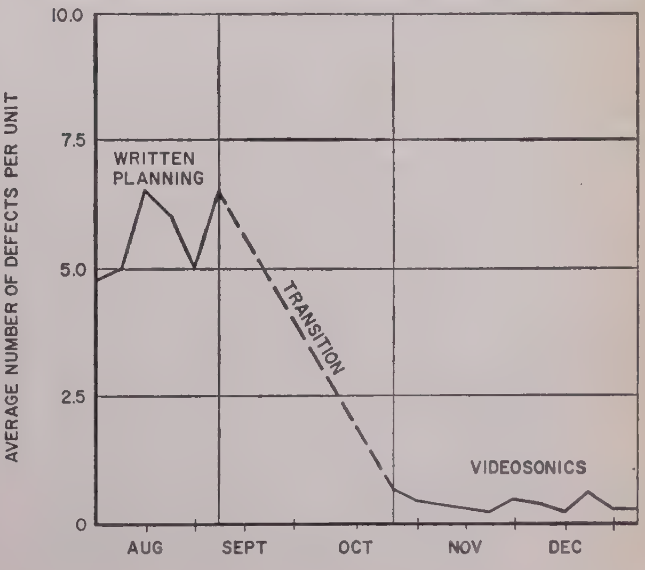
The same experience required in good programming must also be exercised in determining when and where to apply the systems. Attitudes governing any good business practice hold equally true in this case. Audio-visual techniques can and should be justified on the basis of evaluation and care in selection of applications. Limitations can readily be ascertained. Investment in equipment, cost of programming and savings to be expected can all be computed in advance. The payoff can be predetermined.

* * *

Chart depicting the sharp rise in productivity. Initial improvement leveled off slightly after the first month, then began a steady climb.



Using traditional planning information, an average of 5½ defects per unit were experienced. After introducing the system, defects =0.05%.



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Programming for Dielectric Constants

Digital computers are often misused by improper or duplicated programming. Proper use of the numerous programmed subroutines, can eliminate much of this waste. Here's a program for computing dielectric constants and loss tangents.

ALMOST any method that is subject to graphical analysis and graphical solution can be solved by some numerical method on a digital computer. Most digital computer facilities have libraries of programmed subroutines. It is only necessary to call for the subroutine where needed in your program. Among the more common subroutines are those for finding $\log_{10}$, $\log_e$, $\sin X$, $\cos X$, $\tan^{-1}X$ and the square root of the absolute value of X. In this program, $\sin X$, $\cos X$, $\tan^{-1}X$, and the $\log_{10}X$ subroutines were used.

A common method of calculating the dielectric constant and loss tangent of a substance, at microwave frequencies, is by use of a shorted line. Numerous papers have explained this method[1]. However, here's a quick review.

The principle used by the shorted-line dielectrometer is based on the phase shift present when a substance is inserted into a waveguide in the presence of standing microwaves. By measuring the voltage standing wave positions and ratios before and after insertion, parameters are obtained which make it possible to calculate the dielectric constant and loss tangent. The number of parameters depends on the statistical method used. A minimum of 6 parameters is required. Besides knowing the phase shift parameters the substance and waveguide dimensions must be known. The frequency determines the free space wavelength. When used to obtain the parameters, the statistical method should be programmed along with the general program for computing the dielectric constant and loss tangent.

Fortran Program

We have written a Fortran (Formula translation) program containing a statistical routine which computes the mean value of several parameters. Twenty-eight parameters per case are submitted to the computer and values of 4 dependent variables are printed out at the end of each case. The accuracy is to 3 significant places. Speed of computation and cost are good. The program requires 0.6 minute for 22 cases.

The formulas used in this program are all contained in the references with the exception of the formula for loss tangent. That formula was derived from the MIT Radiation Laboratory Series, Vol. 11.

The dielectric constant is calculated from the formula

$$\epsilon' = \left(\frac{Q\,\lambda_o}{2\,\pi\,d}\right)^2 + \left(\frac{\lambda_o}{\lambda_c}\right)^2.$$

where ε' = dielectric constant, λ_o = free space wavelength, λ_c = cut-off wavelength of the waveguide, d distance from the surface of the sample facing the wave propagation to the surface of the sample which is against the short, and

$$Q = \frac{2\,\pi\,d \tan Q}{\lambda_g \tan\left(\frac{2\,\pi\,\psi}{\lambda_g}\right)}$$

which reduces to

$$\frac{\tan Q}{Q} = \frac{\lambda_g}{2\,\pi\,d} \tan \frac{2\,\pi\,\psi}{\lambda_g}.$$

where λ_g = wavelength in waveguide without the sample in place.

Perhaps the most difficult part of calculating the dielectric constant this way is in the solution of the transcendental equation involving Q. The expression

$$\frac{\lambda_g}{2\,\pi\,d} \tan\left(\frac{2\,\pi\,\psi}{\lambda_g}\right)$$

is determined in another part of the program.

Assigning C to this expression for the moment we have $\tan (Q)/Q = C$. Tables are easily accessible for values of Q in all quadrants; but, the programmer is faced with the problem of programming the entire table or finding another method of finding Q. Programs have been written that include the part of the tables used most extensively, but these programs are, in general, costly and wasteful of computer time. A less expensive and more direct method of computing Q is concerned with an approximation method, arrived at by empirical methods on an IBM 709 computer.

Loss Tangent

The loss tangent is calculated from the formula

$$\tan \delta = \frac{\Delta \bar{x}}{\lambda_g} \left(\frac{\epsilon - (\lambda_o/\lambda_c)^2}{\epsilon'} \right) \left(\frac{4 \pi \csc 4 \pi \psi/\lambda_g}{4 \pi v \csc (4 \pi v) - 1} \right) - \tan \delta_{\text{wall}}$$

which is written in terms of sin and cos as

$$\tan \delta = \frac{\Delta \bar{x}}{\lambda} \left(\frac{\epsilon' - (\lambda_o \ \lambda_c)^2}{\epsilon'} \right) \left(\frac{4 \pi \sin 4 \pi v}{\sin 4 \pi \psi/\lambda_g (4 \pi v - \sin 4 \pi v)} \right) - \tan \delta_{\text{wall}}$$

where Δ_x = difference in the width of the twice power (3 db up from the null) points of the standing wave minimum with and without the specimen in place, ψ = change in the position of the standing wave minimum after the specimen is inserted into the guide plus the thickness of the specimen, and $V = Q/2\pi$.

The loss tangent is written in terms of sin and cos so that computer subroutines can be used in its calculation.

The loss tangent is found by equating the imaginary parts of the expression

$$\frac{\tanh \gamma_2 d}{\gamma_2 d} = - j \frac{\lambda_g}{2 \, pd} \frac{E_{\min}/E_{\max} - j \tan 2 \pi \psi/\lambda_g}{1 - j \, E_{\min}/E_{\max} \tan 2 \pi \psi/\lambda_g}$$

Equating the real part of the above expression leads to the transcendental equation involving Q. γ is the propagation constant.

The loss tangent due to the wall is calculated from

$$\tan \delta_{\text{wall}} = \frac{2 \, \bar{\Delta} \bar{x}_o (1 - (\lambda_o/\lambda_c)^2)}{n \lambda_g}$$

It is not necessary to program the formula for the part of the loss tangent due to the wall, since the wall losses are relatively constant from day to day. $\overline{\Delta x_o}$ is the change in $\overline{\Delta x}$ between nulls without the sample in place. n is the number of half wave lengths between the nulls.

The method of solving for Q was first written and evaluated as a subroutine of the larger program. The subroutine is not only valuable in this particular program but also in other routines which require the solution of this transcendental equation or related equations such as $\sin (Q)/Q$, and $\cos (Q)/Q$, respectively, equal a constant. A brief description of the method is described here.

Program 1

Instruction No.	Instruction
1.	$Q = R + \tan^{-1} C$
2.	$C_n = \tan (Q_n)/Q_n$
3.	Test to see if $(C - C_n) = 0$ (within selected limits)
4.	$Q_n = \tan^{-1} (C) (Q_n - 1)$
5.	Repeat instructions 2 through 5

Quadrature Arrangement

Quadrature is arranged by either adding 2π, 0, or π to Q. If the first quadrant is desired, add nothing to Q—since most binary computers compute Q in the first and fourth quadrants. Most subroutines for $\tan Q$, $\sin Q$, and $\cos Q$ are written for the first and fourth quadrants; however, it is conceivable that a routine may be written for the third and second quadrants. If the four quadrant is desired, add 2π because it is computed as a negative angle on most computers when it is there. Adding 2π will express the same angle as a positive angle. If we want the second quadrant, add π since Q is negative and such angles are computed in the fourth quadrant. If we need the third quadrant, add π again, because positive angles are computed in the first quadrant. The first approximation to $\tan (Q)/Q$ is made by assuming Q equals the $\tan^{-1} C$.

This value of Q will be larger than the value of Q we are looking for, except for the values of Q that are less than 1.000. This condition arises from the indeterminate form that $\tan (Q)/Q$ assumes when Q approaches 0. L'Hospital's Rule on limits necessitates a limit on Q of 1. From this approximation to $\tan (Q)/Q$ a new value of C is found by taking the tangent of this assumed Q. At this point, a test should be made to determine whether or not the new value of C is equal to the original value of C. The first time through this routine they may not be equal and the machine should be instructed to continue the loop. The second approximation to $\tan (Q)/Q$ is made by taking the arctangent of the original value of C times the first value of Q. With this second approximation to $\tan (Q)/Q$ a new value of C is found by taking

(*Continued on page* 222)

Program 2

Instruction No.	Instruction
1	ψ = phase shift plus d
2	λ_g = 2 (measured half wave in waveguide)
3	λ_o = constant/frequency
4	λ_c = 2 (a)
5	$C = (\lambda_g/2 \pi d) (\tan 2 \pi \psi/\lambda_g)$
6 7 8 9 10	Instructions 6 through 10 are subroutine instructions for computing Q. (See other routine.)
11	dielectric constant $= (Q \lambda_o/2 \pi d)^2 + (\lambda_o/\lambda_c)^2$
12	dielectric constant (corrected) = (dielectric constant uncorrected $- 1) b/b_o + 1$
13	$v = Q/2 \pi$
14	loss tangent $= (\Delta x/\lambda_g)$ (dielectric constant $- (\lambda_o/\lambda_c)^2$)/(dielectric constant) $(4 \pi \sin 4 \pi v/(\sin 4 \pi \psi/\lambda_g) (4 \pi v - \sin 4 \pi v)$ − wall loss factor

This design technique quickly determines the specification parameters to construct a waveguide filter.

Rapid Design of Coupled Coaxial Filters

BAND-PASS Filters using conventional lumped constants, coils and capacitors, have long been a standard practice for eliminating interference at audio, and up to the VHF region.

Above about 4 KMC waveguide sizes become conveniently small for constructing filters giving the excellent response available in a waveguide. In the 1-4 KMC band, lumped constant design is not possible and waveguides are inconveniently large.

Mutually coupled coaxial resonator band-pass filters with closely predicted response can be produced in convenient sizes for this band.

Rapid Design

The design data presented here, demonstrates a quick method for finding all the important parameters from a given set of specifications. This data, is based upon theoretical considerations, but is "practicalized" to allow for experimentally observed differences between theory and practical results.

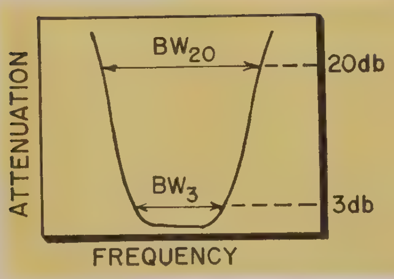

Fig. 2: Experimental Table and Design Data

BW_{20}/BW_3 Relation between required bandwidth and number of cavities. Authors experimental table, consistent with design data Radio Engineers International Tel. & Tel. Co.

TABLE

Greater Than	But Less Than	N – Number of Resonators	K
1.25	1.30	6	9.5
1.30	1.50	5	6.8
1.50	1.80	4	4.5
1.80	3.00	3	2.8
3.00	4.00	2	1.7

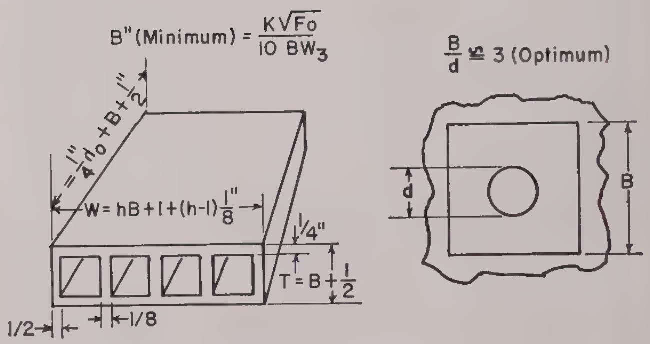

Fig. 3: Cavity Side B, and Filter Dimensions

Design Example

Design a band-pass filter to the following specifications:

Design Center Frequency (f_o)	1270 MC (λ_o = 9.3 inches)
3 *db* Bandwidth (BW_3)	60 MC
20 *db* Bandwidth (BW_{20})	100 MC
Insertion Loss:	Less than 0.5 *db*
Connectors:	Type *N*
(λ_o = wavelength)	

Design Procedure

Number of Resonator — *n* — and insertion loss.

From the table in Fig. 2 and $BW_{20}/BW_3 = 1.666$ *n* is found to be 4.

Use as a good working rule of thumb, for a well designed cavity:

Insertion Loss (*db*) = *n* x 0.1

Therefore: *n* x 0.1 = 4 x 0.1 in. = 0.4 *db*

This specification is found to be realistic.

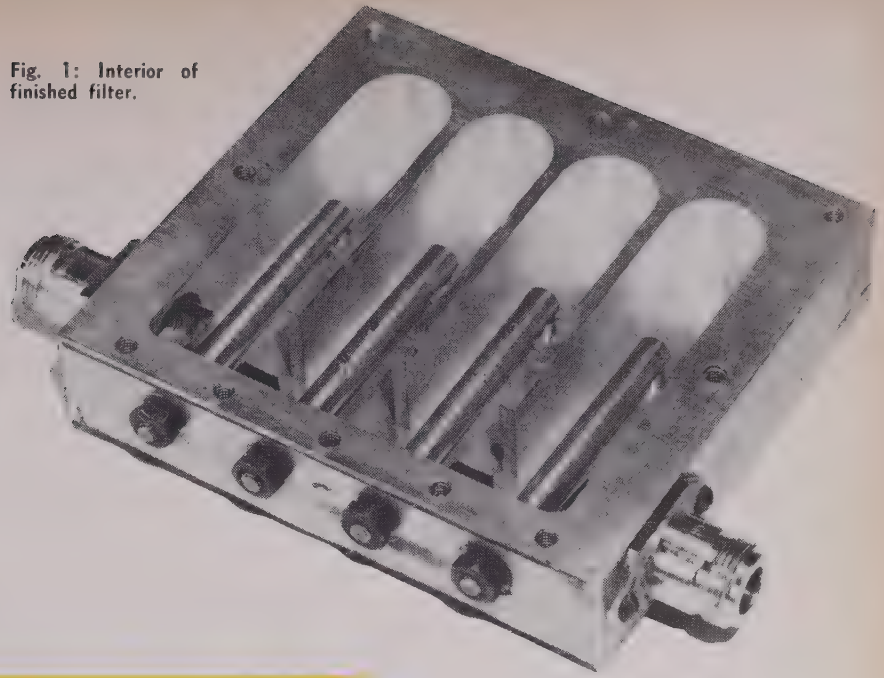

Fig. 1: Interior of finished filter.

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Filter Dimensions

From Fig. 2 and the previous solution:

$$n = 4$$

B minimum is found to be 0.260 in. (0.750 in. is permissible, as it will result in a smaller loss and is more convenient to make mechanically. B should not exceed 0.25 of wavelength.) See Fig. 3.

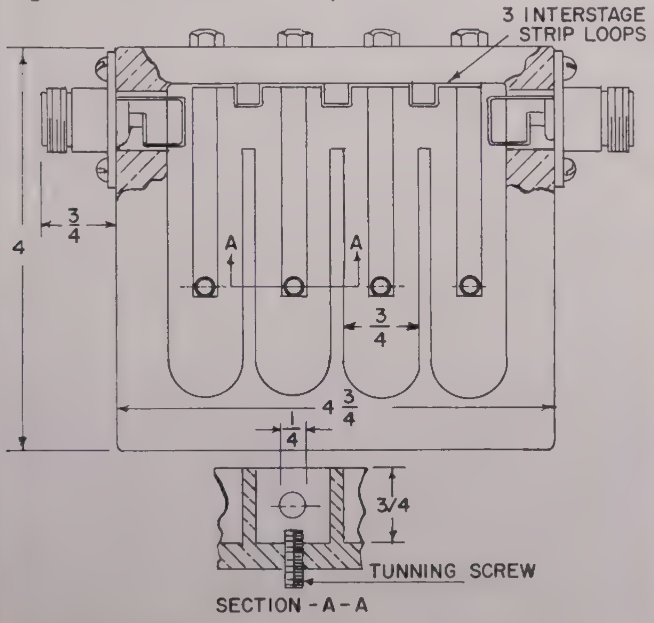
Therefore: $d = B/3 = 0.250$ in.

and: $$W = nB + 1\text{ in.} + \frac{(n-1)}{8} = 4.375\text{ in.}$$

$$T = B + \tfrac{1}{2}\text{ in.} = 1.250\text{ in.}$$

$$L = \frac{\lambda_o}{4} + B + \tfrac{1}{2}\text{ in.} = 3.57\text{ in.}$$

Fig. 4: Construction Details and layout details



Construction and Experimental Refinement

The photograph Fig. 1 shows the internal structure of the finished unit. Initially, openings were made in common walls to give interstage coupling loops, these openings were repeatedly widened in an attempt to obtain greater coupling.

When these openings reached the point of diminishing return ($\cong \lambda_o/12$) interstage coupling loops were introduced, and their size refined under a sweep display until critical coupling was reached. Fig. 4 shows a scaled layout of the filter. The response curve from this design is shown in Fig. 5.

Cautions

Interstage leakage destroys filter response k in the form of high insertion loss, and unsymmetrical curves; to prevent this the cavities were milled in a solid brass block, the cover, and its mating surface was finished ground. In order to eliminate some remaining leakage, a 0.005 in. copper sheet was sandwiched between the cover and the block.

Input and output coupling loops must be identical to obtain the lowest insertion loss of which the filter is capable. The tolerance becomes more important with increasing design center frequency.

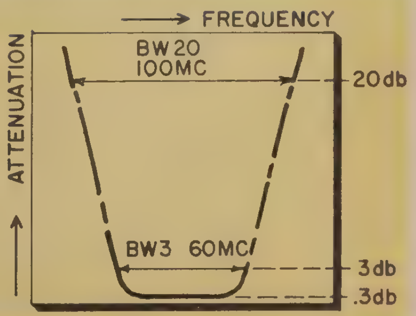


Fig. 5: Response Curve.

What's New

Electro-Optical Potentiometer

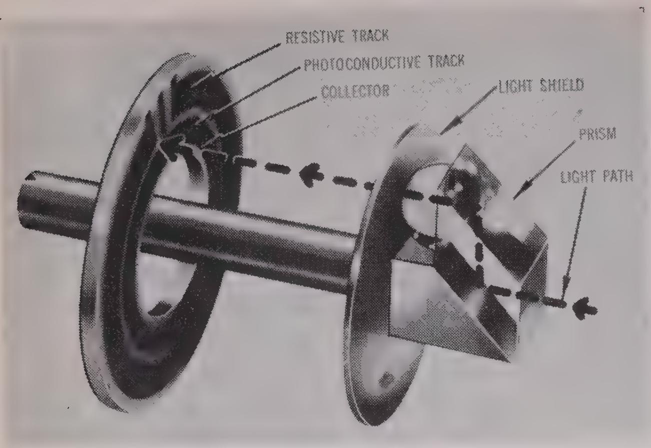


Fig. 1: Basic operating elements of the electro-optical pot.

A DIFFERENT approach is used in the operating principle of the Electro-Optical Potentiometer from Duncan Electronics, Inc., Costa Mesa, Calif. Figure 1 shows the basic operating elements. A light beam is directed from a source (not shown) along an axial path to the prism on the pot shaft. The beam is deflected radially by the prism, so as to strike the annular photoconductive track at the point determined by angular shaft position.

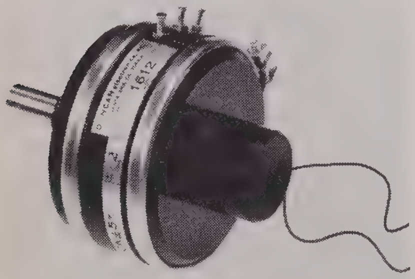


Fig. 2: Circular cover, with wires attached, contains light source.

High conduction is set up at the point where the light strikes the photoconductive semiconductor track. This completes the circuit between the collector and resistive track.

Normally passive, the semiconductor reacts to light by becoming highly conductive. Light-to-dark conductivity ratios, of customarily used CdS or CdSe, range from 10^6 to 10^8:1.

By using a light source instead of a conventional wiper arm, reliability is gained through the elimination of friction. The absence of torque, associated with mechanical wiping action, suits the Betapot® for uses, such as in gyro systems requiring negligible drift.

Since the resistive element need not be wire wound, high resolution and absence of contact noise are possible. The design also allows hermetic encapsulation of the active electronic elements. Resistance values range from below wire-wound to beyond film pots.

The Betapot was developed in cooperation with Electro Radiation, Inc., of Santa Monica, Calif.

* * *

Teflon® Splices In Exotic Environments

TEFLON has proved of great value as a wiring insulator capable of meeting rigid military requirements. But it has resisted conventional methods of splicing required in exotic environments. Such a splice must have the same hermetic integrity, physical properties, and chemical inertness as the original product.

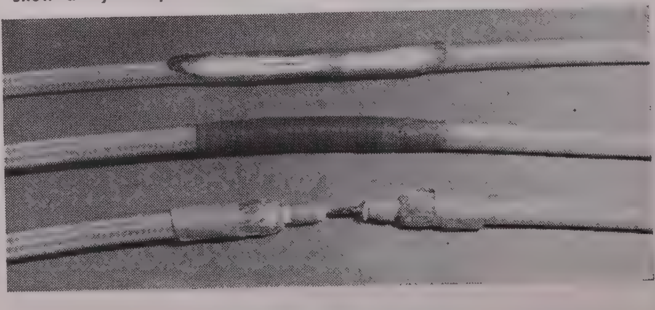
The Martin Co. has developed two processes for uniting the original Teflon insulation with an overlay of the same material.

Adaptability is a major advantage. In the field or in the factory, connectors or encapsulated components having Teflon insulated leads can be replaced; tee or multiple connections can be made easily; duplicate wiring can be eliminated; and connectors or terminal boards in orignal designs can be dispensed with.

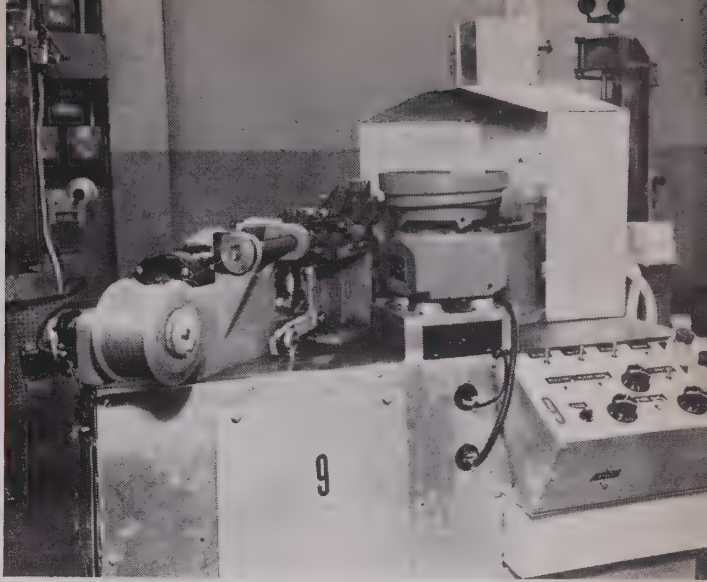
Material for this item supplied by Richard E. Glenn and E. Grant Hood, Electronics Mfg. Engineering, The Martin Co., Baltimore, Md.

Hermetically sealed splices fall into two categories. (1) All processes in which the Teflon splicing material contracts around the splice, eliminating the need for pressure dies. Shrinking and curing are effected by a portable heating unit. (2) Processes requiring

Fig. 1: Results of splicing process applied to coaxial cable. Lower specimen shows cable prepared for application of splicing materials. Center specimen shows completed splice wrapped with tape stock (tube or tape may be used). Upper specimen has been cut away to show unity of spliced materials.



Diode Glass Beading Machine

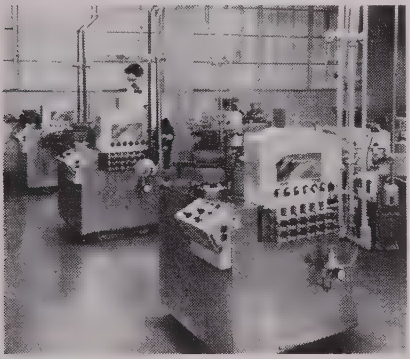


This diode glass beading machine feeds, straightens, seals and inspects units with a loss of less than 10 out of each 1,000 starts.

ONE of the basic steps in the production of high quality diodes is making a uniform beaded lead. The trick in attaching a wire to a small glass bead is to provide uniformity, concentricity, high quality and speed. Up to now, the glass beading machines used by Transitron Electronic Corp., at its Melrose diode facility, have been semi-automatic, requiring the attendance of several skilled operators, and providing a yield which left "room for improvement."

Recently, the Mechanical Engineering Department delivered to the Melrose plant, several newly-developed, completely automatic glass diode beading machines made at the firm's machine shops in the new East Boston plant. Each of the new machines has a capacity of 3600 completed assemblies per hour, bettering by more than 50% the speed of earlier models. The closeup of the machine in the accompanying photograph illustrates some of the operations performed, including feeding, straightening, sealing and inspection of the units. Certain parts of the operation are not shown since they are considered proprietary.

Each of these machines has a capacity of 3600 completed assemblies an hour.



During the beading process, dumet wire on large spools (shown at left on machine) is fed through a wire straightener, measured and cut off to the proper length. The cut is a critical step since burrs or other imperfections would mean rejection of the device further along the production line.

Meantime, the glass beads, having been pre-cut are fed through the vibrating hopper (round bowl at center top), inspected, automatically sorted and positioned on the wire within 0.003 in. The assembled parts then go into a series of fires where they are preheated, sealed and annealed. After the annealing operation, the parts are automatically picked off and dropped into a gauging device which culls out any rejects. The loss of starts on these machines

(*Continued on page* 204)

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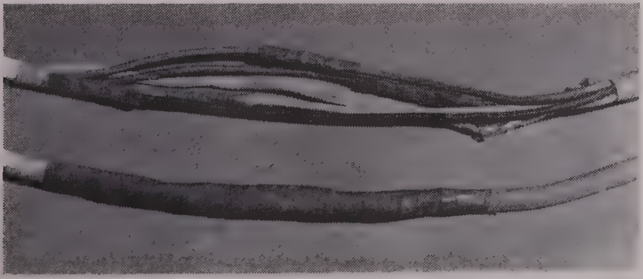
pressure dies made to the configuration of the splice. These processes require a head-and-pressure source for forming the splicing material to such configuration.

The method of these splices is fairly simple. After the conductors are joined by any conventional method, the cut-away volume of insulation is replaced with Teflon FEP (fluorinated ethylene propylene copolymer) film or tube stock. An additional layer of Teflon TFE (polytetrafluoroethylene) is then added, in the form of an expanded tube, or unsintered tape. The entire splice area is then covered with a thin layer of foil. Heat is applied to the area by means of a portable unit blowing heated air over the splice. This heating is accomplished in a matter of 20 sec. to 5 min., depending on the size of the wire or cable being spliced. The foil is then removed, and the splice is complete. The foil serves a very important function: it allows a high-temp. heat source to be used for rapid curing, while transmitting the heat quickly and rapidly to the Teflon, without allowing the Teflon to exceed its sublimation temp. This avoids degradation of the material, and prevents the generation of harmful gases.

Fig. 2: Two specimens of spliced Teflon four-conductor shielded cable. Upper specimen shows cable spliced by the old or conventional method. Lower specimen, a splice by the new process, shows that shield has been retained and that entire cable keeps its hermatic seal. Neither of these features was possible in the old method.



In Category II, the method of assembling the splice is like that of Category I, except that Teflon TFE flat stock is used instead of expanded tubing or unsintered tape. In this process, the use of foil is unnecessary, since its function will be served by a heated die. This method is most suitable for multiple splices, where the geometry does not lend itself to a shrinking outer layer of material.

Internal noise is always difficult to predict.
As usual, two approaches are possible—
mathematical and empirical.
Using the latter this article shows
how an accurate prediction can be made.
And the required design data
can be obtained by applying tests
to the external terminals of the transistor.

For Transistor Users . . .

How to Design Low-Noise Amplifiers

By **FRANCIS OPP**
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Texas Instruments Incorporated
P.O. Box 312, Dallas 21, Texas

NOISE is any unwanted signal present in an amplifier. It is a combination of external noise, noise present in the signal source, and internal noise.

External noise is variable and is generally considered to be beyond the control of the designer. The signal source is usually resistive and will only generate thermal noise. There are three types of internal noise: thermal, shot, and excess or l/f noise.

Thermal noise is caused by the random motion of carriers in the transistor's bulk resistance. Shot noise can be attributed to random diffusion of minority carriers and to random recombination and generation of hole-electron pairs. l/f noise can be attributed to fluctuations in the current density caused by some modulation mechanism.[1] Generally l/f noise is divided into a component caused by random changes at the transistor's surface and a component caused by random variations in the leakage path around the transistor's junctions.

Specifying Noise Performance

The method used to specify noise performance should present it in as accurate, complete, and readily usable form as circumstances will permit. Two approaches are possible.

The first is a mathematical approach, requiring a thorough understanding of the physics of the internal noise. This analysis has the feature that knowledge of the internal noise mechanism is obtained along with the required design information. The theory of shot and thermal noise can predict transistor noise performance with a high degree of accuracy. This is not true for l/f noise. Theories covering this type of noise are available[1,2] but they suffer from at least two deficiencies: accurate prediction of results is not possible, and the theory is not in a form easily used by designers. l/f noise is the primary concern over the lower portion of the audio frequencies; therefore a mathematical approach is not yet realistic for the circuit design engineer.

The second approach is empirical. The required design information can be obtained by applying tests to the external terminals of the transistor. This method has the advantage of not requiring a knowledge of the internal noise physics.

Definition and Measurement

Many quantities can be used as a measure, or figure of merit, for noise performance. A very useful term is the noise factor, F, which is defined as the factor by which the signal-to-noise power ratio is degraded when the signal is passed through a network. F is also the ratio of S/N at the input of a network, $\frac{S_i}{N_i}$. to the S/N at the output of the network, $\frac{S_o}{N_o}$. Expressed mathematically

$$F = \frac{S_i N_i}{S_o N_o} \qquad (1)$$

We must have a basic understanding of F. To do this, we must first define the term available power which is used to simplify the finding of F. Fig. 1 is a simple circuit whose signal source is E_g, with an internal resistance, R_g.

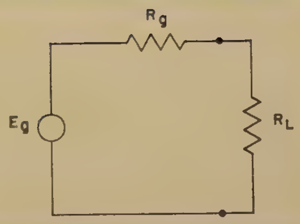

Fig. 1: Circuit used in defining the term available power which in turn is used to simplify finding the noise factor.

The maximum power which E_g can deliver to R_L is

$$P_{L\,(max)} = \frac{E_g^2}{4\,R_g} \qquad (2)$$

This quantity represents the maximum available power, or simply the available power, of the generator.

Now consider Fig. 1 with an additional generator, E_n, to represent the open circuit thermal voltage associated with R_g, and a 4-terminal network connected between R_g and R_L, Fig. 2. The mean squared noise voltage inherent in any resistance is:

$$E_n^2 = 4\,KTBR_g \qquad (3)$$

where,

E_n = rms noise voltage (volts)
k = Boltzmann's constant (1.38 x 10^{-23} joules/°K)
T = temperature of the noise source in °K, and
B = equivalent noise bandwidth of the system (CPS).

From Fig. 2 the available input signal power is

$$S_i = \frac{E_g^2}{4\,R_g} \qquad (4)$$

while the available input noise power is

$$N_i = \frac{E^{\ 2}}{4\,R_g} = KTB \qquad (5)$$

The signal to noise power ratio at the input is therefore:

$$\frac{S_i}{N_i} = \frac{E_g^2/4\,R_g}{KTB} = \frac{E_g^2}{4\,KTB\,R_g} \qquad (6)$$

Substituting Eq. (6) into Eq. (1) we have

$$F = \frac{E_g^2}{4\,KTB\,R_g} \Big/ \frac{S_o}{N_o} \qquad (7)$$

The output signal-to-noise ratio can for convenience be expressed as a voltage ratio.

That is

$$\frac{S_o}{N_o} = \frac{E_{os}^2/R_L}{E_{on}^2/R_L} = \frac{E_{os}^2}{E_{on}^2} \qquad (8)$$

where: E_{os} = the rms value of the output signal and
E_{on} = the rms value of the output noise,

$$F = \frac{E_g^2}{4\,KTB\,R_g} \Big/ \frac{E_{os}^2}{E_{on}^2} \qquad (9)$$

For purposes of measurement the above expression can be converted to

$$F = \frac{E_{on}^2}{4\,KTB\,R_g\,(G)^2} \qquad (10)$$

where: $$G = \frac{E_{os}}{E_g}$$

The test circuit is shown in Fig. 3. The signal generator consists of an oscillator feeding a resistive network. The test jig has the transistor to be tested and its biasing circuits. The amplifier used was selected for low-noise, linearity and dynamic range. The filter has narrow passbands at about one octave intervals over a 250 CPS to 100-KC frequency range. The equivalent noise bandwidth of each passband must be determined. The output meter should be a true rms voltmeter. This testing arrangement allows the measurement of narrow band noise factors for wide ranges of generator resistance, bias conditions and frequency.

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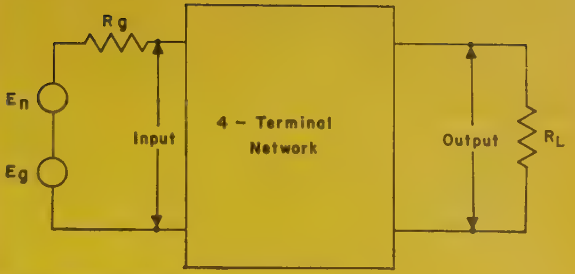


Fig. 2: General circuit used for derivation.

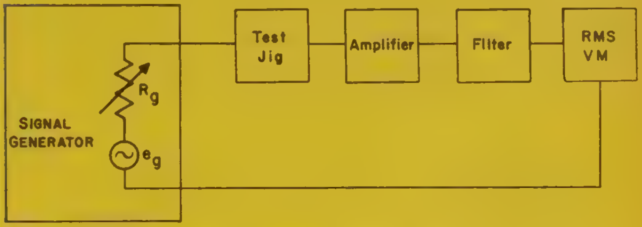


Fig. 3: Test circuit used to determine noise factor.

Unit	fα mc.	h_{ib} ohms	h_{fe}	h_{ob} x10^{-6}	h_{FE}	I_{CBO} m μ a
1	33	50	93	0.28	58	0.74
2	36.8	53	96	0.20	64	1.3
3	38 7	52	101	0.20	65	1.5
4	35.2	54	98	0.24	60	0.65
5	36	53	96	0 30	55	1 23
6	35.4	52	100	0 25	65	0 77
7	34	52	100	0.29	60	0 45
8	32.6	51	91	0 26	58	0 73
9	32.5	55	102	0 30	55	0 35
10	34.8	52	92	0 30	58	0 65

Fig. 4: Parameters of transistors selected for testing.

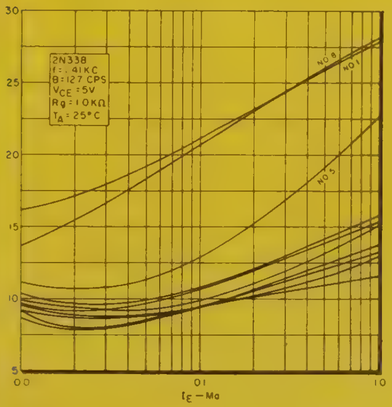


Fig. 5: Plot of the individual transistors as emitter current is varied with fixed frequency and generator resistance.

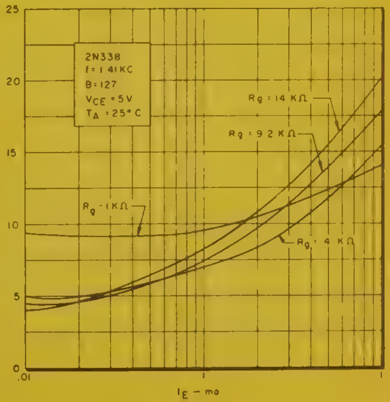


Fig. 6: Plot of the averages of 3 transistors for F vs. I_E using various values of generator resistance.

Low-Noise Amplifier *(Continued)*

Transistor Noise Data

For low-noise, the designer must know: what range of noise factors can be expected from a given transistor; what has to be done to get this performance; and, what compromises must be made with respect to other types of circuit performance to obtain the desired results. To supply this information, the following data must be obtained:

1. The relation between generator resistance, R_g; emitter current, I_E; collector-to-emitter voltage, V_{CE}; and noise factor, F,
2. F *versus* frequency,
3. F *versus* temperature
4. Minimum and maximum limits on F, and
5. Gain and bandwidth *versus* current level.

In any testing procedure, the first problem is the selection of transistors. Based on the theory of shot noise, a transistor should have a high $f\alpha$, a high h_{fe}, and a low I_{CBO} to maximize its performance in the shot region. Ten 2N338's were selected with these characteristics. Their parameters are shown in Fig. 4.

To obtain the necessary design information, noise factors of the 10 units were measured at a fixed frequency and generator resistance over an emitter current range of 0.01 to 1.0 ma. This data is plotted in Fig. 5. Based on the information in this plot the 10 transistors were divided into two groups, units No. 1, No. 5, and No. 8 in one group and the remaining units in the other. Three transistors were selected from this second group and considered typical low-noise units. The noise factors of these units were measured over ranges of R_G, I_E, and temperature. V_{CE} has negligible influence on F below a level of about 10 volts due to the 2N338's extremely low values of I_{CBO} and h_{ob}. For this reason, all noise factors were measured with $V_{CE} = 5$ volts.

Fig. 6 is a plot of F *versus* I_E using various values of R_g. The curves shown are the average values of the three units. Fig. 7 is a single plot, similar to Fig. 6 but using much higher values of R_g. Figs. 8, 9, and 10 are plots (averages of 3 units) of F *versus* I_E using 3 different values of R_g for $T_A = -52$, $+25$, and $+100$°C. Fig. 11 shows the variation of gain with I_E for fixed values of R_g and R_L. A study of this data reveals several important facts:

1. Transistors with similar data sheet parameters will not necessarily have the same noise performance.
2. For a given value of R_g, an emitter current can be chosen to minimize F.
3. For a given value of I_E, a value of R_g can be chosen to minimize F.

To compare the selected units with "off-the-shelf" 2N338's, the noise factors of a random sample of 50 were measured at 2 frequencies with fixed bias and generator resistance. The distribution shown in Fig. 12, indicates that approximately 25% of the 50 units achieve or surpass the performance of the selected units at $f = 1.41$ KC.

In addition to measuring the noise factors of single transistors, a compound connection was measured, the results of which are given in Fig. 13. This type of connection should give better noise performance than the common-emitter stage at higher generator resistances.

Figs. 14 through 16 show typical noise performance of the TI-490 mesa transistor (J-570A). Fig. 14 shows the noise figure distribution of 50 units. The noise figures of 5 units, selected as shown, were measured at $I_E = 0.05$ ma, $V_{CE} = 5$ volts and $f = 1$ KC for various values of R_g. The spread is shown in Fig. 15. Fig. 16 shows the F *versus* f of a single unit for two I_E and R_g combinations.

Design of Low Noise Amplifier

The noise data contained in the last section serves as a very useful tool in the design of low-noise amplifiers. The additional information needed is the relationship between the transistor's noise factor and the noise factor of the amplifier. Eq. (11) called Friis' formula, will supply this information:

$$F_A = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_2 - 1}{G_1\,G_2} \tag{11}$$

where; F_A = noise factor of the amplifier,

F_1, F_2, F_3 = noise factors of the transistors used in the various amplifier stages measured at their operating bias and impedance levels, and

G_1, G_2 = available power gains of the first and second stages.

Fig. 7: Single plots of higher R_g values.

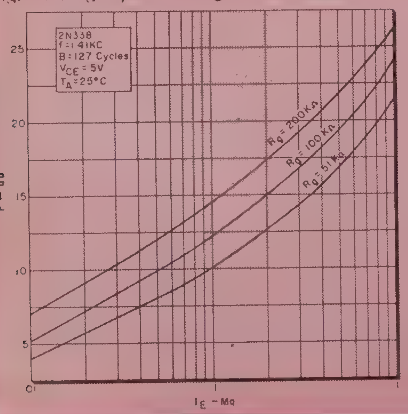


Fig. 8: Average plots for varied temps.

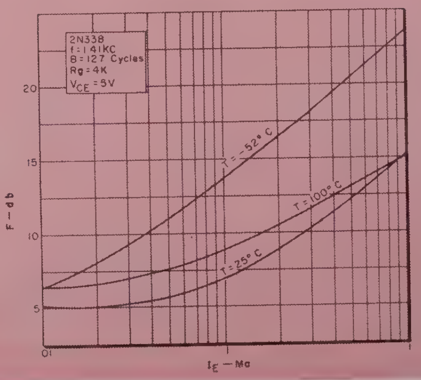
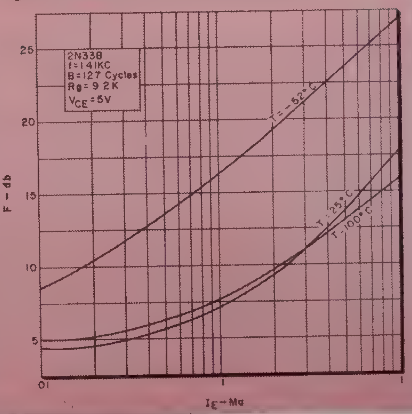


Fig. 9: Similar to Fig. 8, different R_g.



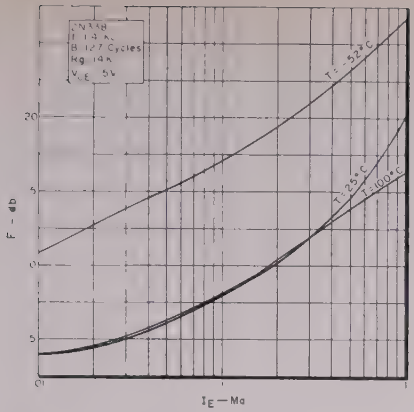
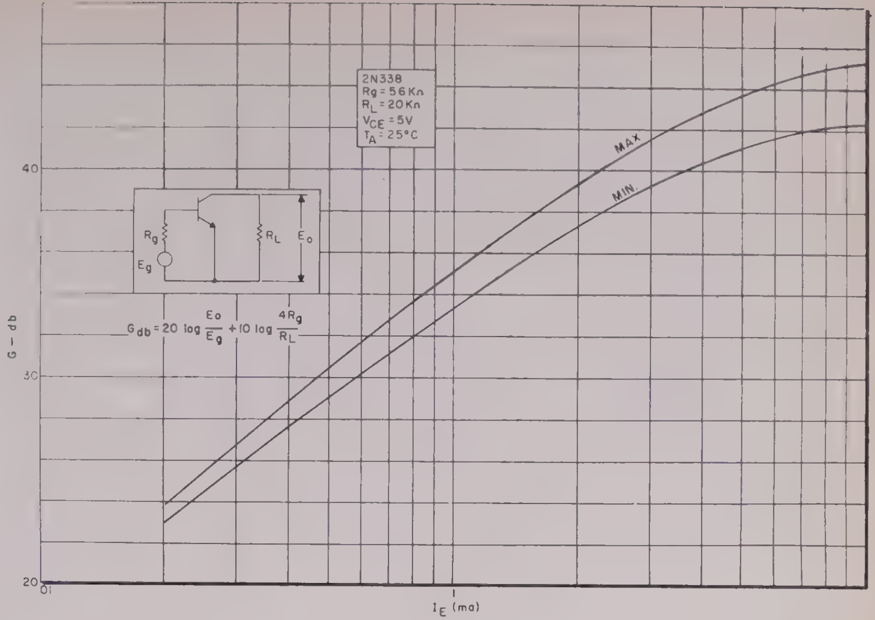


Fig. 10 (above): Similar to Figs. 8 and 9, but with another generator resistance.

Fig. 11 (right): Variation of gain with I_E for fixed generator & load resistances.



This expression is valid only if the individual stages have the same noise bandwidth. In most low-noise applications, the contribution of noise from the third stage can be neglected, thus simplifying the above equations to:

$$F_A = F_1 + \frac{F_2 - 1}{G_1} \qquad (12)$$

To demonstrate how the presented noise data can be used the test amplifier in Fig. 17 was designed. The amplifier was driven with an R_g = 5.6K ohms. The data in Fig. 6 shows that a first stage noise figure of 5 db (f = 1.41 KC) can be achieved if the transistor is biased at $I_B \doteq 20$ μa and $V_{CE} = 5$ volts. The resistor values chosen for the bias network are determined by the bias stability factors[4]

$$S_1 = \frac{\partial I_C}{\partial I_{CBO}} = \frac{R_B + R_E}{R_B(1 + h_{FB}^*) + R_E} \qquad (13)$$

$$S_2 = \frac{\partial I_C}{\partial V_{BE}} = \frac{h_{FB}^*}{R_B(1 + h_{FB}^*) + R_E} \qquad (14)$$

$$S_3 = \frac{\partial I_C}{\partial h_{FB}^*} = S_1 I_{Eq} \qquad (15)$$

where; R_B = Thevenin's equivalent resistance of base bias supply,

R_E = external d-c emitter resistance,

$h_{FB}^* = \frac{I_C - I_{CBO}}{I_E}$, and

I_{Eq} = the quiescent emitter current.

The total collector current change is equal to the sum of the individual changes. The effect of the base divider network and any un-bypassed emitter resistance, R_e, will always increase the transistor's minimum noise factor for a given bias condition, $F_{(min)}$,

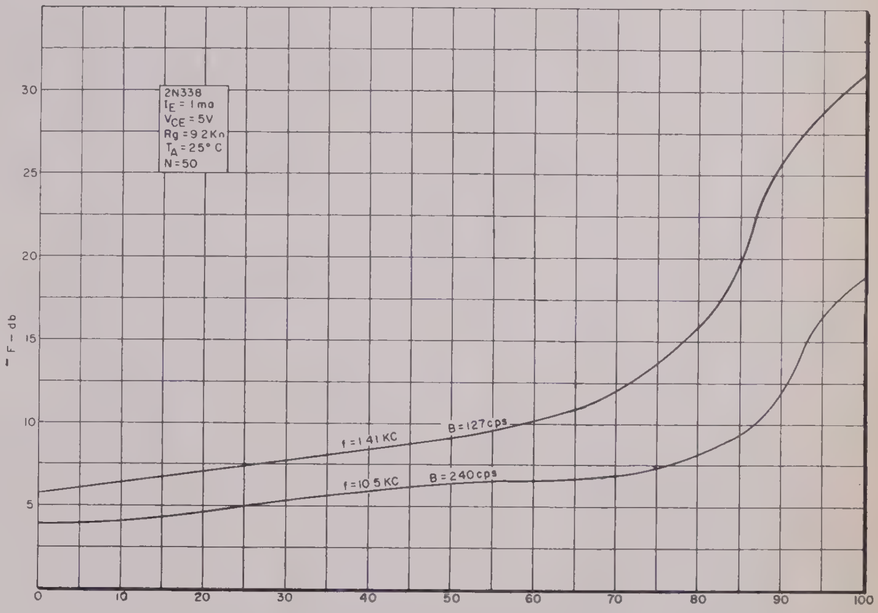
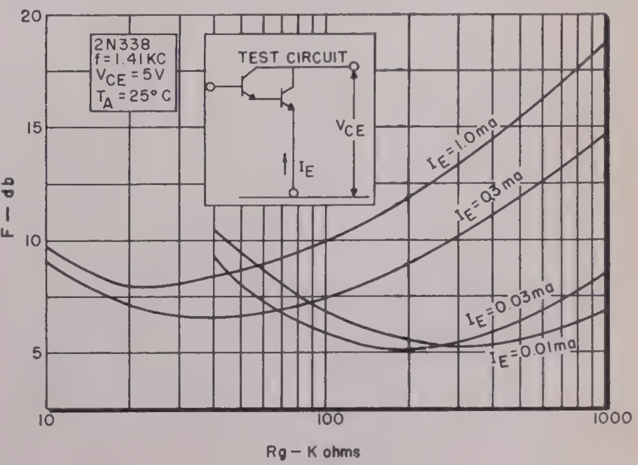


Fig. 12: Distribution of the noise factors of a random selection of 50 transistors at 2 frequencies with fixed bias and R_g.

Fig. 13: Results of measuring the noise factor when the compound connection was made as shown in the illustration.



Low-Noise Amplifier *(Concluded)*

Fig. 14 (below): Noise figure distribution for 50 TI-490 mesa transistors.

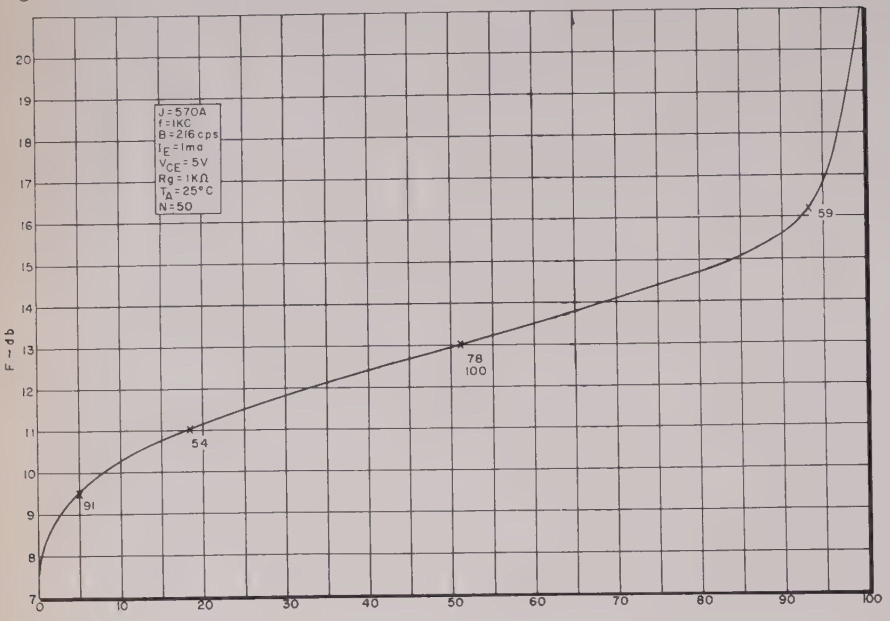


Fig. 15 (below): Spread of 5 units, selected and tested as shown.

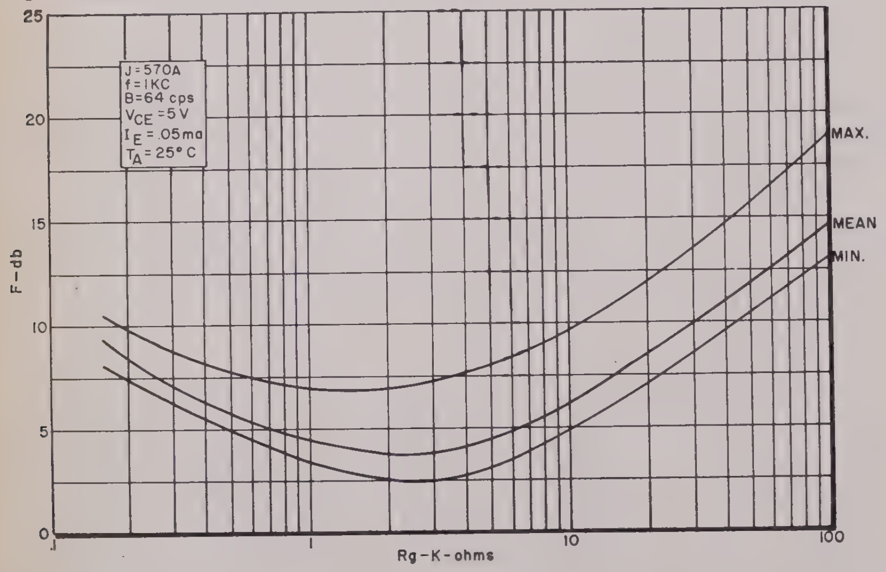
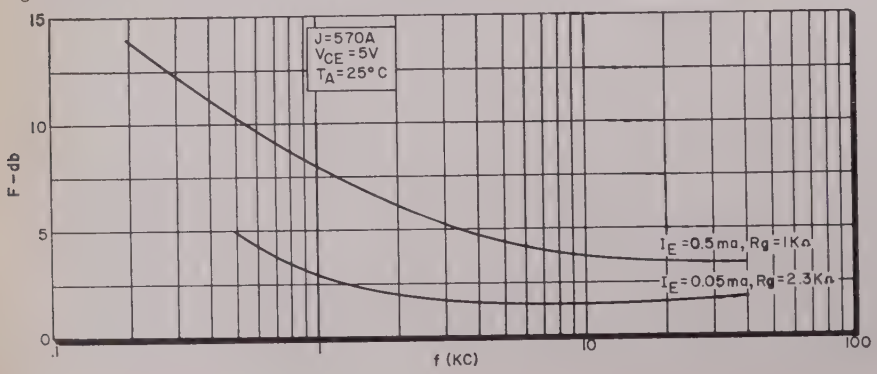


Fig. 16 (below): Noise factor versus frequency for one unit, different conditions.



and will increase or decrease the value of R_g required to give this minimum, $R_{g(opt)}$.[5] If the following conditions are satisfied however, this effect will be negligible:

1. $R_B/R_g > 10$
2. $R_s/R_g < 10$

The second stage is operated at $I_E = 100\ \mu a$ *and* $V_{CE} = 5$ volts. The generator resistance seen by this stage is equal to the parallel combination of the base-bias network and the d-c collector load resistance of the first stage. This results in $R_g \approx 100K$ ohms for the second stage. Fig. 7 gives an approximate $F = 12.3$ db. Referring to Eq. (12):

$$F_A \approx F_1 \tag{16}$$

$$\text{if } \frac{F_2 - 1}{F_1} << F_1 \tag{17}$$

In this application;

$$\frac{F_2 - 1}{G_1} = 0.1\ F_1 \tag{18}$$

This was considered a great enough difference for the noise of the second stage to be neglected. The gain of the first stage necessary to satisfy this condition is

$$G_1 = \frac{F_2 - 1}{0.1\ F_1} \tag{19}$$

Inserting the known values of F_1 and F_2 gives:

$$G_1 = \frac{17.2 - 1}{0.1\ (3.16)} = \frac{16.2}{0.316} = 51.3 = 17.1 \text{ db} \tag{20}$$

The a-c load of Q1 is approximately Q2's h_{ie} which is about 20K ohm for the chosen bias conditions. Fig. 11 shows that the necessary gain can be obtained.

The first stage gain requirement can be reduced if the generator resistance seen by the second stage is nearer optimum. The obvious method is to use transformer coupling. For RC coupling the value of R1 should be as small as possible.

The remaining amplifier design is straight forward unless some type of feedback is employed for a-c stability. The effect of feedback on the noise factor and its optimization depends on the particular application. This topic is covered in various references.[5,6]

Amplifier Performance

Noise performance of the test amplifier is shown in Figs. 18 and

19. Fig. 18 is a plot of F_A *versus* frequency, while Fig. 19 shows F_A *versus* R_g. Comparison of these plots with Figs. 6 and 7 shows reasonable agreement. Remember that the data is based on evaluation of typical units and averages of typical units, therefore a direct comparison is not possible. F_A was measured at f = 1.41 KC and T_A = 100°C using two different transistors in the first stage. The noise figures were 5 db and 5.2 db respectively. Measurements were also made at T_A = —52°C. The measured noise figures were 15 db and 20 db. It is obvious that the conditions for $F_A \approx F_1$ do not hold at this temperature. This condition is due primarily to the increase in F_2 and the decrease of G_1 at $T_A = -52°C$.

Transformer coupling between the first and second stage would give a substantial improvement in amplifier performance for low temperatures. This is primarily due to the lower values of F_2 obtained by optimizing the R_g seen by the second stage. Several points must be kept in mind while evaluating the variation of noise factor with temperature. The data is based on only three units, there is no justification for saying all 2N338's will have the same characteristics. Surface conditions play a major part in l/f noise which helps to explain why this type of noise is so unpredictable.

The compromises necessary for low-noise performance are due to the low levels of emitter current required. This low-level reduces the magnitude of h_{fb} and $f\alpha$. These reductions do not place a serious handicap on 2N338 performance over the audio range. If operation over wider frequency ranges are required, then the primary compromise will be between bandwidth and noise performance.

Conclusion

This data shows that the l/f noise of the 2N338 can be minimized by suitable transistor biasing and input termination. Figs. 6 and 19 indicate that operation of the first stage at specified current levels allows the circuit designer a wide range of generator resistances from which to drive the stage without a serious degradation in noise performance. Also, if reasonable care is given to the coupling network between the first and second stages, satisfactory performance can be achieved over the wide temperature range possible with silicon transistors.

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3. Friis, H. F., "Noise Figures of Radio Receivers," *Proc. IRE*, vol. 32, p. 419, 1944.

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5. Middlebrook, R. D., "Optimum Noise Performance of Transistor Input Circuits," presented at the Philadelphia Transistor and Solid State Circuits Conference, Feb. 1958.

6. Van Der Ziel, A., *Noise*, Prentice-Hall, Inc., New York, 1954.

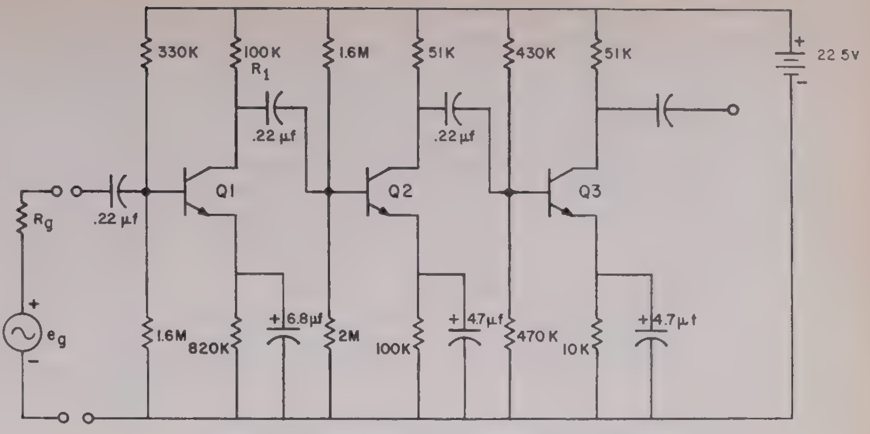

Fig. 17: Schematic of the low noise test amplifier.

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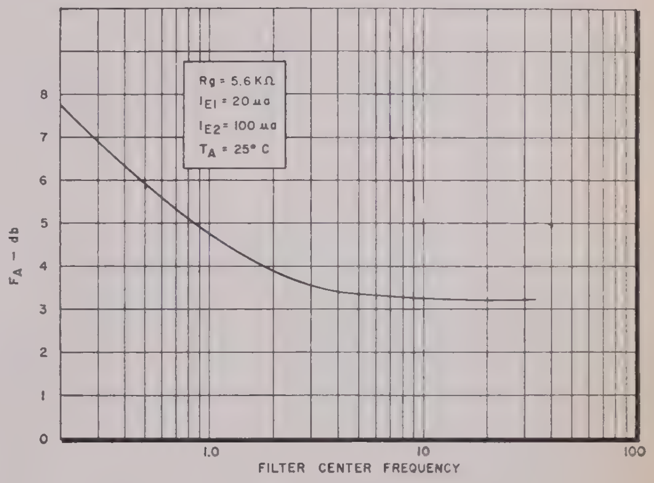
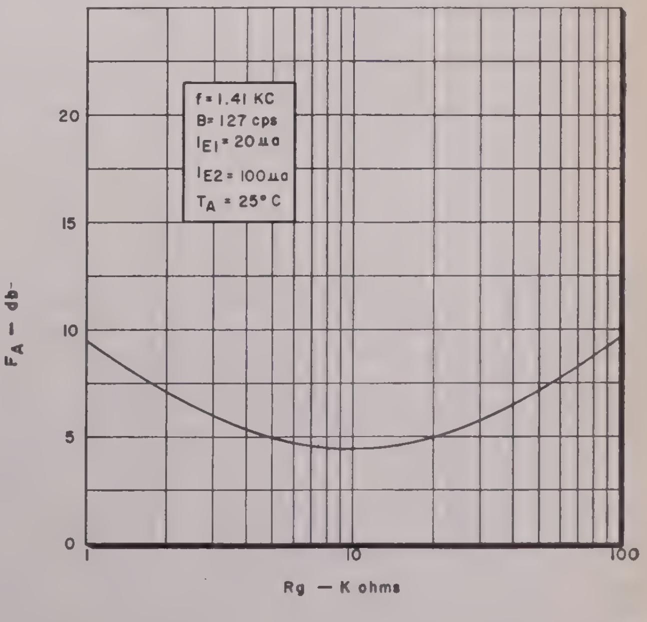


Fig. 18 (above): Test amplifier noise factor versus frequency.

Fig. 19 (below): Variation of amplifier noise factor with R_g.



Page from an Engineer's Notebook

#59—90° Emitter-Follower Phase Shifter

By E. G. FONDA
Research Specialist
Lockheed Missile/Space Div.
Palo Alto, Calif.

THIS novel design describes a simple, low frequency phase shifting network integrated with an "active" device providing power and impedance matching features.

Most single phase-shifting networks are readily controlled by use of an ac bridge circuit (such as the wheatstone type).

More often than not, it is assumed that no appreciable current will be drawn by the load selected. If so, then two distinct disadvantages will occur; first, excessive *source* power may be necessary; secondly, reflected impedance variations will occur when adjusting phase control.

These problems can be resolved by the unique approach shown in Fig. 1. This features a similar "bridge" design, only the CT is in the transformer's primary side, with the common-collector configuration supplying the power.

Here, by reversing the normal bridge procedure and feeding the input signal being shifted into the center of the bridge arrangement, it is possible to control the vectors IX_c and IX_1 across C_2 and L_1. Consequently a 90° phase shift signal appears across the transformer's primary winding. This is then inductively coupled to the load via the secondary winding. This uses the common-collector's natural advantages; i.e., power gain, impedance matching properties, and little or no phase reversal.

Transformer design calculations:

$$
\begin{aligned}
\text{Given, } R_L &= 1300 \\
E_o &= 30 \text{ v rms} \\
I_L &= 23 \text{ ma rms} \\
P_o &= 0.69 \text{ w} \\
Z_{pri} &= N^2 I_s = \tfrac{1}{2}\, 1300 = 650 \\
I_{pri} &= N\, I_s = 32.5 \text{ ma rms} \\
E_{pri} &= N\, E_s = 21.4 \text{ v rms} \\
P_{pri} &= E\, I = 0.69 \text{ w}
\end{aligned}
$$

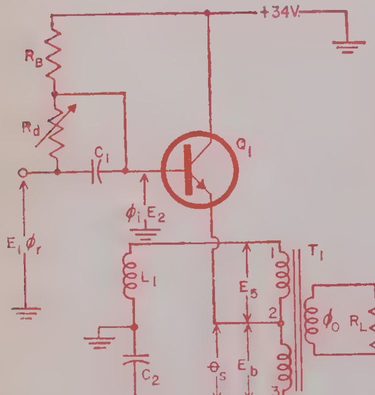
The circuit provides a constant signal voltage (± 5%) with a variable phase feature (90° ± 20°), while eliminating most standard phase-shifters inherent disadvantages. Other advantages for this circuit include: low harmonic distortion; increased reliability through simplicity; compact packaging; and low dc power required.

Because of component flexibility, almost any audio frequencies (60, 400 CPS, etc.) and/or input signal magnitudes can be handled. Initial design considerations for transistor selection would center around the critical parameters; maximum alpha cutoff frequency, F_{ao} and allowable emitter-base junction voltage (higher the better).

Circuit operation is straight forward. Fixed bias is secured for the common-collector stage by R_B connected from the collector to base. This establishes the dc quiescent point for base current selected; with the series dc resistance of the inductor and ½ of the primary winding serving as the dc load line for the transistor, Q_1. Superimposed upon this dc load line of approximately 20 ohms, is the 650 ohm ac load reflected from the secondary. Manipulation for a desired phase position is possible by adjustment of R_d in shunt with C_1. At a precise phase shift of 90°, this value was 21 Kilohms.

The CT transformer must be of a fairly good quality. This particular unit, in conjunction with the emitter-follower stage, developed a slight phase angle to the real axis ($\theta_s - \phi_{ref}$) or reference point (Fig. 2). However, this universal a-f transformer contained nearly equal CT primary windings, turns ratio of 1:1.4, and was capable of handling the 200 ma dc unbalanced primary current through taps 1-2 This was necessary to maintain the correct dc bias for class A operation of the emitter-follower power stage. Analysis of the phase rotation through 90° reveals how the 10 KC shifter functions (see Fig. 2).

Possible circuit applications are: industrial phase control of thyratron tube conduction; control synchro and resolvers' phase drift or shift, and demodulator reference signals.



Parts List

R_d = 100K, 1.5W, Var.
R_B = 18K, 1/2W ± 5%
Q_1 = T.I. 2N1050
C_1 = 1500 μμf, 300V. DC
C_2 = 0.047 μf, 200V. DC
T_1 = 1:1.4, 10KC
L_1 = 2-4 mh in Series Miller #4551

Fig. 1: Emitter-follower phase shifter provides its own power.

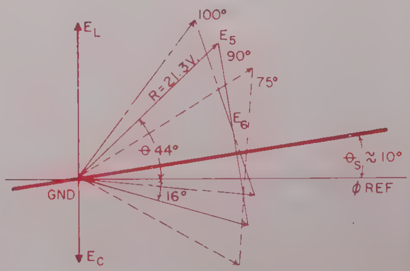
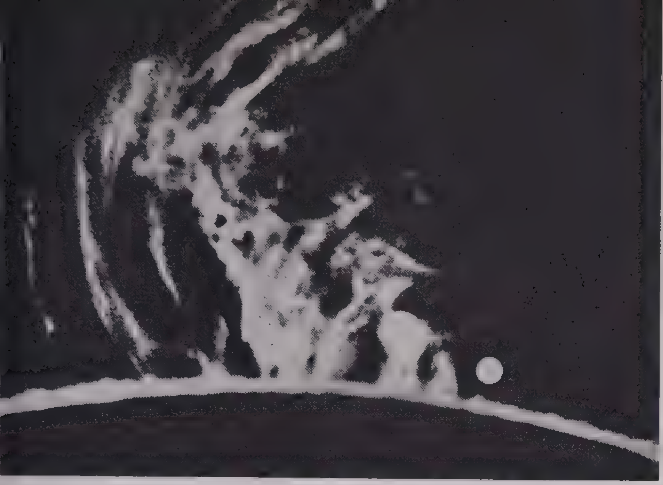


Fig. 2: Phase shift vector diagram across R_L.



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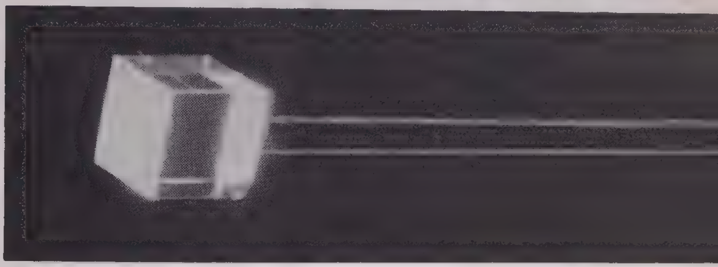
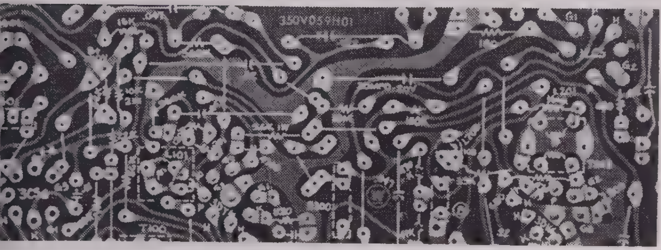
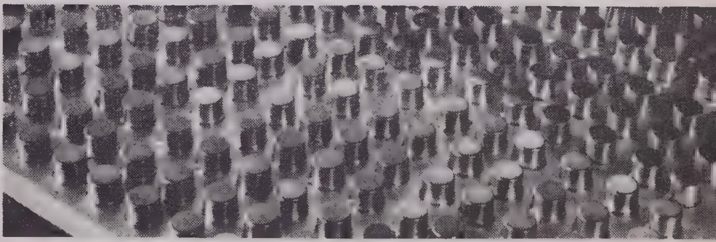
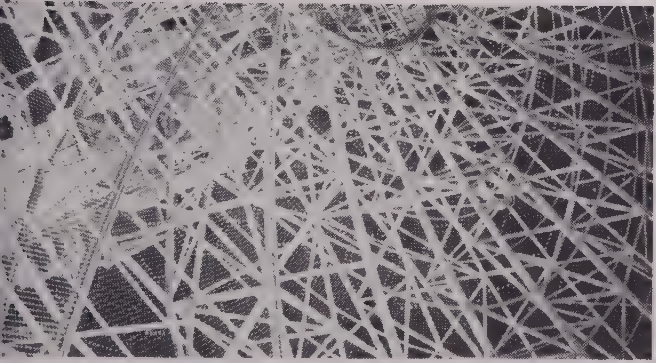




1961 WESCON

Francisco / Cow Palace / August 22, 23, 24, 25





WESCON provides one of the world's most important technical forums. About 120 authors will cover the latest developments, during forty panel sessions. The themes will include radio astronautics, coherent light generators, and quantum electronics. Over 1200 booths will display the latest hardware achievements, and include sections for production and materials, and publications.

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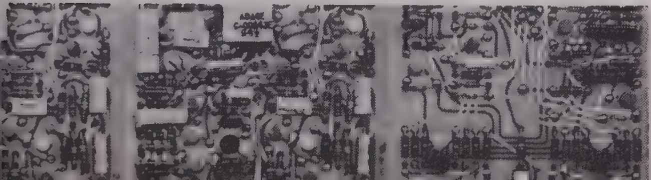
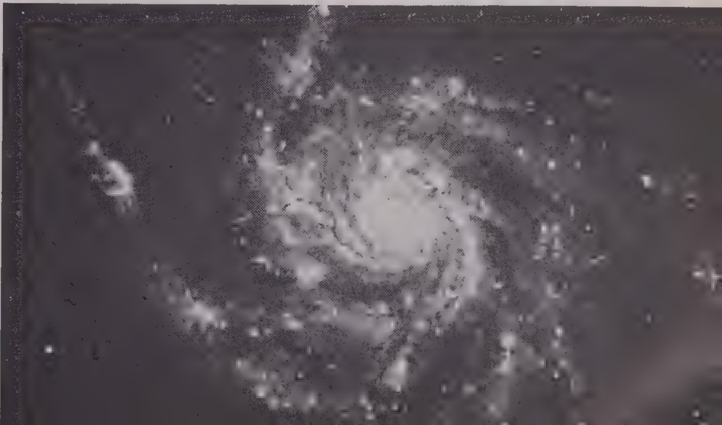




- **Technical Sessions**
- **Product Exhibits**
- **Field Trips**
- **Social Activities**

1961 Western Electronic Show

ON Monday, August 21st, the 1961 **Wescon** Show Convention should draw its biggest attendance of engineers and executives. It is anticipated that over 35,000 will visit the electronic exhibitions at San Francisco's Cow Palace.

The Institute of Radio Engineers and the Western Electronic Manufacturers Association are co-sponsors of the convention, which is the West's greatest technical trade show.

The four days of the convention provide the best opportunity for a comprehensive study of the vast electronics' panorama, and to obtain up to the minute information on the latest scientific discoveries. Under the 41 technical sessions there are 123 papers by the nation's most brilliant engineers.

An interesting leaflet has been published by the **Wescon** board, requesting the cooperation of exhibitors to eliminate overt recruiting at the show, and also suggests ways to ensure the success of company social activities.

A Gentleman's Agreement

Recruiting for engineers has blighted many an engineering gathering. It is apparent that aggressive recruiting of technical personnel has no place in a forum of scientific professionals and it is requested that all participants will join in a "Gentleman's agreement" and render a service to industry by eliminating this practice.

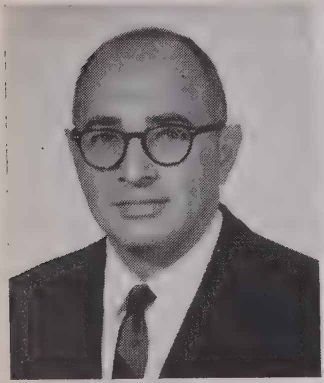
The tradition of entertaining fellow professionals and friends of the company is a pleasant and relaxing part of the **Wescon** gathering. These social functions can enhance the importance of the occasion, and become integrated with the professional atmosphere of the convention. However, excesses in company-sponsored gatherings can mar the objectives for which they were planned. They can distort the public image of an entire industry.

It is well to remember that every company is constantly on public view, and social events are one way in which the public takes a close look at the corporate image.

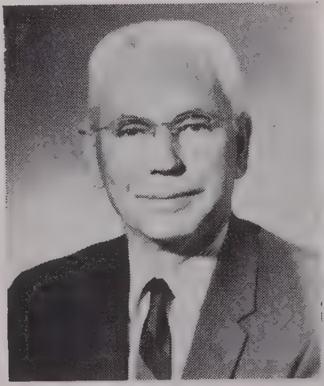
Technical Sessions

The 41 technical sessions are the result of six months intensive study, in fields calculated to provide the most interesting program for engineers. A major new field in the 1961 program is that of coherent optical emission, and six excellent papers are to be given on this subject. Papers are also

O. H. BROWN
Chairman Executive Committee



JOHN V. N. GRANGER
Convention Director



CALVIN K. TOWNSEND
Show Director

ALBERT J. MORRIS
Chairman of the Board

and Convention

E. W. Herold and L. G. Clarke check the final selection of papers to be read at the technical sessions.

being presented on the ruby optical maser, solar systems communications, and a session in coherent light radar, which will be given a practical demonstration.

Another new development to be disclosed at the **Wescon** is a completely new type of amplifier which uses no electrical currents or electrical effects. It is also quite different in behavior from conventional solid-state effects.

There will be many papers dealing with information theory, computers and new applications. An unusual feature in this respect is the Iliac computer, of the University of Illinois, which is being used as a teaching machine—in this first task it is teaching its own operation and uses.

The major aspects covering the development of particle accelerators will be discussed. An enlightened understanding of nuclear physics should be achieved from information resulting through studies of the three largest installations in the USA; the Princeton-Pennsylvania accelerator; the Brookhaven National Laboratory Machine, and the Argonne Laboratories installation.

Another 'first' to be heard at **Wescon** concerns a new industrial radio-graphic apparatus capable of producing high intensity x-rays which can examine very large objects, such as solid-fuel missiles, in only minutes. This development is expected to revolutionize much of industrial radiography.

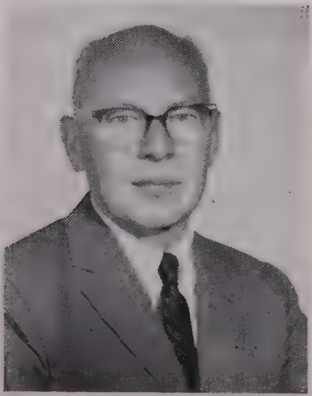
Sessions are also being given on radio astronomy,

WESCON Sidelights . . .

Each year some companies have special meetings and get-togethers outside of the regular show activities. This year the following companies have reported their activities as:

COMPANY	EVENT	TIMES AND DATES	LOCATION IN SAN FRANCISCO	PERSONNEL IN ATTENDANCE
Hoffman Electronics Corp. 1001 N. Arden Drive El Monte, Calif.	Annual reception and cocktail party	5:00–7:00 PM 8/23/61	Fairmont Hotel Terrace Room	
Motorola Semiconductor Products 5005 E. McDowell Road Phoenix, Ariz.	Transistor Symposiums Solid State Pwr. Sup. Design Epitaxial Mesa Switching Applic. Mesa Amplifier Applications	9:00–10:30 AM 8/23, 8/24, 8/25	Mark Hopkins Hotel Golden Empire Room	Ralph Greenberg Glen Madland Peter Myers William Roehr Douglas Taylor
Alpha Metals, Inc. 56 Water Street Jersey City 4, N. J.	Hospitality Suite	6:00–10:00 PM 8/22, 8/23, 8/24	Hyatt House (Burlingame)	Richard E. Le Bond Martin A. Boyle Jack Hagestad Stanley Turkus
Hysol Corp. Olean, N. Y.	Sales Meeting	8/21, 8/22	Hunington Hotel	
The Superior Electric Co. 83 Laurel Street Bristol, Conn.	Discussion of special product applications	4:00–10:00 PM 8/22, 8/23, 8 24	Mark Hopkins Hotel Garden Room	Joseph S. Louden Eugene Williams Oliver Mahannah Marvin Stokem Milton Hollingsworth Charles Blum Dave Young
Telecomputing Corp. 16217 Lindbergh Avenue Van Nuys, Calif.	Special exhibits and demonstrations of new materials	Evenings 8/22, 8/23, 8 24	Del Webb Town House	Robert Poet George Whitbread
Silicon Transistor Corp. 150 Glen Cove Road Carle Place ,L. I. ,N. Y.	STC's Diamond Jim Club (by invitation only)	From 8:00 PM 8/22, 8/23, 8/24	Sheraton Palace Hotel California Room	Robert L. Ashley Laurence Le Bow Abe Kosakowsky Bill Gray Jerrold Krasny

DON E. LARSON
Manager of Wescon



WESCON *(Continued)*

satellite, and space communications. Including a session of stereo FM broadcasting.

Night Session on Arms

One of the world's most vital subjects will be discussed in the special Wednesday night panel on arms control. The program is coordinated through a technical committee headed by Edward W. Herold, vice-president for research at Varian Associates, and Dr. John V. N. Granger, president of Granger Associates, and convention director.

Representatives from the Department of Defense, and from The Joint Chiefs of Staff will attend the discussion. Dr. Granger commented, that an increasing number of the finest engineering and scientific minds have devoted much thought to the complexities of reconciling the need for disarming with the impossibility of disarmament. The problems of technical, military, and psychological aspects will be discussed. Dr. Van Atta, recently special assistant for arms control in the office of the Director of Defense, Research and Engineering, will lead the session. It is expected that this session will draw a capacity house of 1700 from the **Wescon** visitors, and pack California Masonic Memorial Temple on Nob Hill.

Field Trips

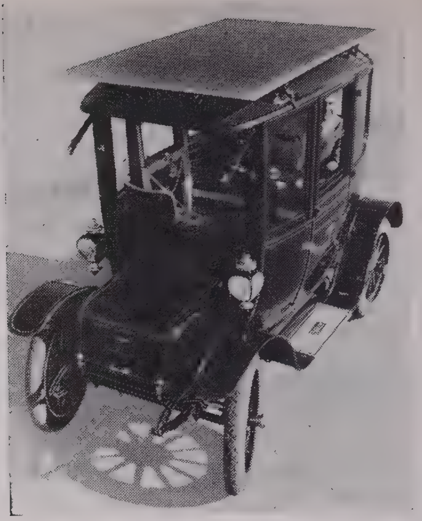
A sampling of research and production activities in the San Francisco Bay area will be featured in the field trips program. These visits are all closely related to the major sections of the technical program.

Tuesday afternoon, August 22—Litton Industries' Electron Tube Division at San Carlos, to inspect high-power and super-power tube facilities; the University of California's Lawrence Radiation Laboratory at Livermore, where emphasis will be placed on basic work in plasma research (this tour is limited to 50).

Wednesday afternoon, August 23—Stanford University Microwave Laboratory will provide an opportunity to learn about research in two fields; that is (1) ionized cesium plasma and (2) electron guns and ion propulsion engines. Another tour visits the joint Radio Field Site of Stanford University and Stanford Research Institute, with its wide variety of experimental installations used for radio-astronomy projects.

Thursday morning, August 24—MELABS, in Stanford Industrial Park at Palo Alto, for a general tour of new facilities devoted to research, development and production of microwave devices (including cavity masers, S-band traveling-wave masers and L-band parametric amplifiers).

Solar Powered Automobile



The roof of this car is fitted with the largest solar panel ever assembled and used 10,640 silicon solar cells. The electric operated car was a project of International Rectifier Corporation of El Segundo, California.

Thursday afternoon, August 24—Hewlett-Packard Co. and its newly expanded center in Stanford Industrial Park, with attention to be concentrated on production areas (prefabrication, wiring and assembly, test and calibration, quality assurance).

Vice-chairman of the Field Trips Committee is Robert E. Miller of Stanford Electronic Laboratory.

Ladies Program

The convention makes a warm welcome for the wives and women visitors to the show. A most interesting program is prepared to make their visit to the Golden Gate memorable and stimulating. The Women's Activities Room, and the California Room on the mezzanine of the lovely Fairmont Hotel will be used as the ladies' headquarters. Committee members will be there every day from 9 to 5 to greet visitors and assist them in registering, and planning special entertainments. A very glamorous leaflet has been published by the **Wescon** Committee describing an elegant four days' activities, while the men-folk are engaged in the world of technology.

Show Committees

Leading executive responsibilities for the 1961 Western Electronic Show and Convention have been established with the naming of the principal positions on the **Wescon** board of directors.

Chairman of the **Wescon** board for 1961 is Albert J. Morris, president and general manager of Radiation at Stanford, Palo Alto. Chairman of the executive committee is O. H. Brown, assistant for corporate relations, Eitel-McCullough, Inc., San Carlos.

Convention director is Dr. John V. N. Granger, president of Granger Associates, Palo Alto, and show director is Calvin K. Townsend, vice-president of Jennings Radio Manufacturing Corp., San Jose. The manager of **Wescon** is Don Larson who has been prominently identified with the West Coast electronics industries for the past 15 years.

TECHNICAL PAPERS PROGRAM

Tues., Aug. 22—A.M. Sessions

BROADBAND ANTENNAS

Chairman: Ray Justice, Granger Assoc.
"Log-Periodic Resonant-V Arrays," P. E. Mayes and R. L. Carrel.
"Design Criteria For Log Periodic Antennas," Claes T. Elfving.
"Properties of a Pair of Wire Grids For Use In Lens-Type HF Antennas," M. Andreasen and R. L. Tanner.

NEW MICROWAVE ELECTRON DEVICES

Chairman: S. T. Mendel, Hughes Aircraft Co.
"The Coaxial Magnetron, A Superior Microwave Power Source," H. M. Olson and L. H. Von Ohlsen.
"Analysis of a Crossed-Field Waveguide Amplifier," W. C. Brown and G. E. Dombrowski.
"Beam-Plasma Amplifiers," M. A. Allen and G. S. Kino.

HIGH SPEED LOGIC

Chairman: James B. Angell, Stanford University.
"Relationships Between Device And System Design Factors In U. H. F. Computers," E. P. Stabler.
"ASI—A High Speed Anti-Saturation Inverter Logic Circuit," H. Ditkofsky and A. I. Pressman.
"A Tunnel Diode—Tunnel Rectifier, 15 Nanosecond Memory," M. M. Kaufman.

TECHNOLOGICAL ADVANCES IN MILITARY ELECTRONIC EQUIPMENT

Chairman: K. T. Larkin, Lockheed Missiles & Space Div.
"Considerations For The Design of Micro-Module Equipment," B. I. Andrews.
"Engineering Problems In Establishing A Thin Film Circuit Manufacturing Capability," J. C. Gioia.
"Development Of Components For Timm (Thermionic Integrated Micro-Module) Systems," W. A. Barrows and E. J. Broderick.

ELECTRO-OPTICAL COMPONENTS

Chairman: W. Dale Fuller, Lockheed, Missiles & Space Div.
"A Contactless Infinite Resolution Potentiometer," P. H. Wendland and H. H. Houdyshell.
"The Photoreed—A New Versatile Frequency-Sensitive Control," F. H. Inderwiesen.
"A New Approach To Digital Displays Using Electroluminescence," E. O. Stone.

Tues., Aug. 22—P.M. Sessions

CURRENT AND FUTURE RADIO ASTRONOMY AND TECHNIQUES

Chairman: Prof. H. Weaver, University of Calif.
"Low Noise Receivers," P. D. Strum.
"Developments In Antenna Techniques For Radio Astronomy," Emile-Jacques Blum.
"Radio Astronomy In The Solar System," E. A. Lilley.
"Radio Astronomy Beyond The Planetary System," Gart Westerbout.

SOLID STATE DEVICES I

Chairman: Prof. James F. Gibbons, Stanford Univ.
"Superconductor Solenoids," R. W. Boom and R. S. Livingston.
"Parametric Quartz Amplifier," C. H. Becker.
"Terrestial Determination Of Solar Cell Short Circuit Under Outer Space Solar Illumination," H. K. Gummel, F. M. Smits and A. R. Froiland.

COMPUTER APPLICATIONS

Chairman: John Reid Anderson, Stanford Research Institute.
"Plato: An Automated Teaching Device," D. Bitzer, P. G. Braunfeld and W. Lichtenberger.
"The User Looks At The Information Storage And Retrieval Field," R. R. Segel, Daniel Mann.
"An Advanced Digital Data System For Use In Nuclear Reactor Development, W. V. Botts, Jr.

SIGNAL SELECTION

Chairman: Prof. Norman Abramson, Electrical Engg. Dept., Stanford U.
"The Application Of Time/Frequency Correlation Functions To The Continuous Waveform Encoding Of Message Symbols," C. A. Stutt.

R & D PERSONNEL MANAGEMENT AIDS

Chairman: Oscar T. Simpson, Philco Corp., Palo Alto, Calif.
"Effectiveness Of Engineering Employee Tests," K. V. Newton.
"A Case Study Of Performance Evaluation For A R/D Lab," Arnold Addison and Henry L. Yeagley, Jr.

Industry Commentary: J. A. Morton, H. D. Ross, A. N. Curtiss, D. W. Pugsley.

Wed., Aug. 23—A.M. Sessions

RADIO ASTRONOMY ANTENNAS

Chairman: Charles E. Seeger, Radio Astronomy Institute, Stanford University.
"The Diffraction Theory Of Large Aperture Spherical Reflector Antennas," A. C. Shell.
"Correlation Antennas With Non-Uniformly Spaced Elements For Incoherent Sources," L. C. Davenport and C. J. Drane.
"A High Resolution Radio Telescope," J. L. Yen and D. A. MacRae.

STEREOPHONIC F-M BROADCASTING

Chairman: R. A. Iseberg, University of California.
"Standards For Stereophonic Broadcasting," Harold Kassens.
"Stereophonic F-M Receivers And Adapters," D. R. von Recklinghausen.
"Converting F-M Broadcasting Stations For Stereophonic Transmissions," James Gabbert.

HIGH DENSITY TAPE RECORDING

Chairman: Erwin Tomash, Ampex Computer Products
"Reproduction And Equalization Of Pulses From A Magnetic Tape System," G. J. Fan.
"High Density Digital Magnetic Tape Recording," C. N. Batsel and W. L. Ross.
"Pulse Resolutions From Magnetic And Hall Reproduce Heads," Irving Stein.

DETECTION AND SIGNAL PROCESSING

Chairman: R. G. Davis, Lockheed Missiles and Space Div.
"Crosscorrelation With Binary Signals," G. R. Cooper.
"Threshold Comparison Of Phrase-Lock, Frequency-Lock and Maximum Likelihood Types Of FM Discriminators," J. J. Spinker, Jr.
"Classification and Evaluation of Coherent Synchronous Sampled Data Telemetry Systems," A. J. Viterbi.

MICROWAVE COMPONENTS AND TECHNIQUES

Chairman: Edward M. T. Jones, Stanford Research Institute.
"Microwave Variable Attenuators And Modulators Using P-I-N Diodes," J. K. Henton and A. G. Ryals.
"The Isomodulator," Howard Scharfman.
"A Practical Approach To The Design Of Parametric Frequency Multipliers," G. Leuttgenau, J. Williams and H. Miyahira.

Wed., Aug. 23—P.M. Sessions

METHODS OF RELIABILITY IMPROVEMENT

Chairman: R. A. Davis, 3417 Kenneth Drive, Palo Alto, Calif.
"Redundancy And The Detection Of First Failures," D. C. James and A. H. Kent.
"Use Of The Weibull Distribution Function In The Analysis Of Multivariate Life Test Results," A. A. Procassini and A. Romano.
"KEWB—A Radiation Burst Test Facility," W. M. Haussler.

INDUSTRIAL ELECTRONICS

Chairman: Robert De Liban, Barrett Electronics Corp.
"A Digital Control System For Refined Oil Blending," C. A. Hill.
"Radiography Of Large Missiles With A Linear Electron Accelerator," J. Haimson.
"The Universal Digital Transducer," A. Blaustein.

NAVIGATION AND AIR TRAFFIC CONTROL

Chairman: Henry Blanchard, Stanford Research Institute.
"Self-Adaptive Flight Control Through Frequency Regulation," R. G. Buscher, K. B. Haefner and M. F. Marx.
"A Pictorial Navigation Situation Display," E. S. Guttmann.
"Air Traffic Control Color Film," M. G. Ettinghoff and P. D. Strosnider.

SIGNAL PROCESSING

Chairman: Prof. Lotfi Zadeh, Electrical Engineering Dept.
"Properties Of Narrowband Waveforms Generated By Clocked Pulses," M. P. Ristenbatt,
"Communication In The Presence of Statistically Dependent Interference," N. Blachman.
"Theory Of Coherent Systems," W. M. Brown and C. J. Palermo.

COMPONENTS IN EXTREME ENVIRONMENTS

Chairman: L. S. Shuey, Sprague Electric Co., Los Angeles, Calif.
"Semiconductors In A Hyper-Nuclear Environment," L. B. Gardner and A. B. Kaufman.
"Thermal Characteristics And Time-Temperature Studies Of Miniature Electrical Connectors," C. Dean Stephenson.
"Transient Radiation Effects In Capacitors And Dielectric Materials," H. W. Wicklein and R. H. Dickhaut.

ARMS CONTROL (DISCUSSION)

Chairman: L. C. Van Atta, Special Assistant for Arms Control Office of the Director of Defense, Research and Engineering.
Current status and future implications of the arms control effort, with particular emphasis on the implications for research and development, will be discussed.

Thurs., Aug. 24—A.M. Sessions

POINT-TO-POINT COMMUNICATIONS VIA SATELLITE RELAYS

Chairman: General J. D. O'Connell, General Tel. & Electronics Lab, Inc.
"Twelve Advantages Of Stationary Satellite Systems For Point-To-Point Communications," S. G. Lutz.
"Techniques For Incoherent Scatter Communication," D. P. Harris.
"The Operational Analysis Of A New York-London Communication Satellite Link By Machine Calculation," W. Williams, Jr., and L. K. Arquette.

CIRCUIT DESIGN FOR EXTENDING PERFORMANCE

Chairman: Victor H. Grinich, Fairchild Semiconductor Co.
"An Analysis Of The Modes Of Operation Of A Simple Transistor Oscillator," J. F. Gibbons.
"Theory And Design Of Wide Band Parametric Converters," E. S. Kuh.
"Stable Low-Noise Tunnel Diode Frequency Converters," F. Sterzer and A. Presser.

NANOSECOND TECHNIQUES

Chairman: Nicholas Pappas, Iconix, Inc.
"Nanosecond Pulse Measurements," C. N. Winningstad.
"A Triggered Nanosecond Pulsed Light Source," T. G. Innes and Q. A. Kerns.
"Analysis And Measurement Of Phase Characteristics In Microwave Systems," P. Lacy.

SYSTEM DESIGN CONSIDERATIONS IN MILITARY ELECTRONICS

Chairman: John Day, Granger Assoc.
"The Role Of Electronics In The Spectrum Concept Of Military Operations," E. Deimel, Light Military Electronics Dept.
"System Design Considerations For Efficient Use Of Automatic Test Equipment," J. Rescoe.
"On The Meaning Of Quantified Maintainability," N. J. Maroulis, Light Military Electronic Dept.

COHERENT OPTICAL EMISSION

Chairman: Prof. J. R. Singer, University of Calif.
"Fundamental Aspects Of Optical Masers," J. R. Singer.
"Some Potentialities Of Optical Masers," B. M. Oliver.
"The Ruby Maser As A Light Amplifier," P. P. Kisliuk and W. S. Boyle.
"Alkali Vapor Optical Masers," H. Cummins.
"Optical Maser Studies At Lincoln Laboratory," H. A. Bostick.
"Repetitive Hair-Trigger Mode Of Optical Maser Operation," M. L. Stitch, E. J. Woodbury, J. H. Morse.

FUTURE ENGINEERS SYMPOSIUM

Chairman: Alan B. Simpkins, Delcon Corp.
This session will be a competition among the five top technical papers by student exhibitors at the Future Engineers Show. The paper judged best by a panel of judges will receive an award of $250.00.

Thurs., Aug. 24—P.M. Sessions

SPECTRUM CONGESTION IN VEHICULAR COMMUNICATIONS

Chairman: Dwight E. Teall, Lenkurt Electric Co., Inc.
"Multi Transmitter/Receiver Installation Problems And Cures," S. Meyer.
"Allocation Of Frequencies For The Mobile Radio Service—Should Changes Be Made?" G. Olive.
"The Use Of The 15 KC Tertiary Channels In The 150 MC Business Radio Service," M. Peckhart.

MICROWAVE TUBES AND PARAMETER MEASUREMENTS

Chairman: Willis H. Yocom, Varian Assoc.
"A Broad-Banding Theory Of The Klystron Amplifier Output Circuit," C. Romiguiere.
"Measurement Of Impedance Offered To The Beam By Klystron Broad-Band Output Circuit," M. Lakits.

(Continued on page 133)

WESCON Industrial Design Merit Awards

FUNCTIONAL BEAUTY

Some of the 23 merit selections made in the 1961 WESCON Industrial Design competition, based on submissions from exhibitors taking part in the Western Electronic Show and Convention.

Chosen from 172 entries in the 3rd annual competition sponsored by WESCON, the merit-winning selections will be displayed in a special exhibit area at the Cow Palace.

A later judging will determine up to 5 "Awards of Excellence" to be announced the opening morning of WESCON. The remaining exhibits will receive the WESCON IDA "Award of Merit."

Fisher Berkeley Corp.
4224 Holden St., Emeryville, Calif.

EKTACOM

Intercom for office, industrial or home use

Design Director: John Crane
Designer: John Crane of Walter Landor & Associates
Project Engineering Supervisor: Robert S. Fisher

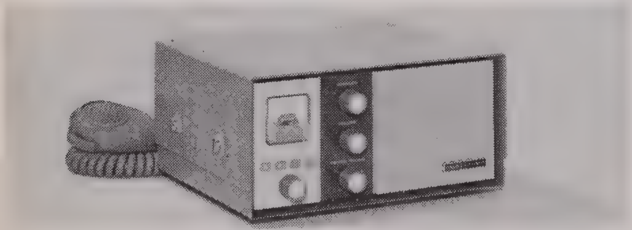
Kaar Engineering Corp.
2995 Middlefield Rd., Palo Alto, Calif.

Designers: Walter Landor & Associates, San Francisco, Calif.
Project Engineering Supervisor: Norman C. Helwig

Kaar D Phone

Radio Telephone for two-way communication in citizen's radio service

Design Director: Walter Landor
Designers: John Crane & Tsugio Kubota



Kaar Conalert III

Monitor for radio broadcast station for Conelrad alert and weather warning

Design Director: Walter Landor
Designers: John Crane & Tsugio Kubota

Kaar Han-D-Phone

Portable transceiver for two-way voice communications by radio
Design Director:
Walter Landor
Designers:
John Crane & Peter Stevens

Cook Electric Co., Data-Stor Div.
8100 Monticello Ave., Skokie, Ill.

Digital Magnetic Tape Transport

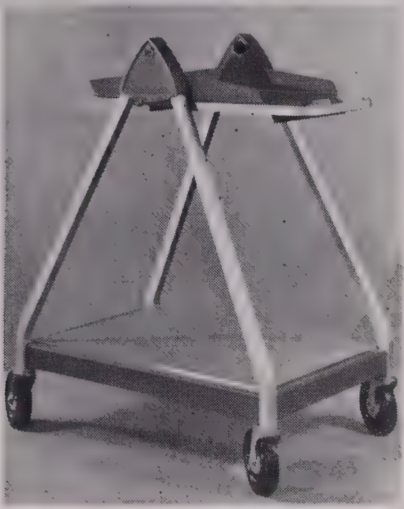
Input-output device for digital computers

Designers:
Mr. Painter; Teague & Petertil
Project Engineering Supervisor:
Elmer Beck

WESCON Industrial Design Merit Awards

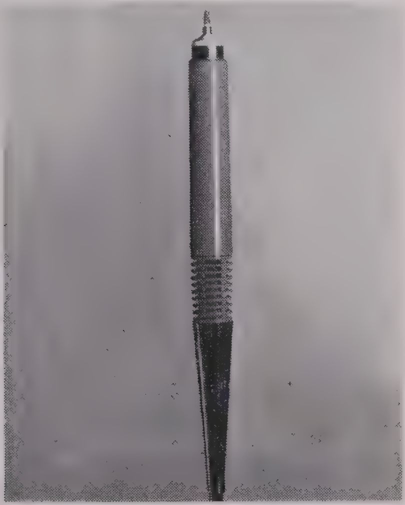
Tektronix, Inc.

Scopemobile



Design Director:
Gale Morris
Designer:
Archie Yergen

High-Frequency Probe



Designers:
Robert G. White
Gale Morris

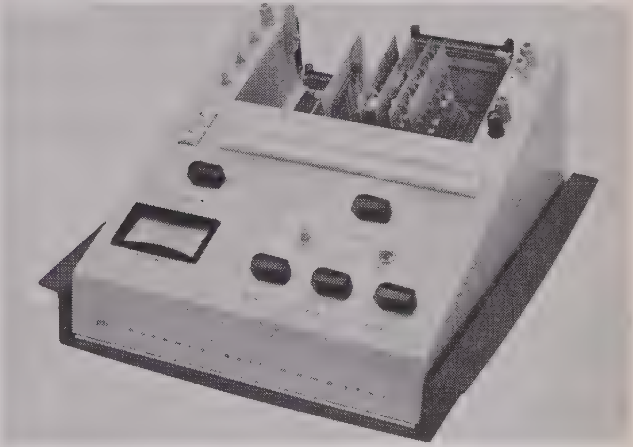
Packard-Bell Electronics Corp., Computer Div.

1905 Armacost Ave., Los Angeles, Calif.

Module Tester MT-1

Instrument for customer use in testing all company modules (electronic circuit boards)

Design Director: Bernard Caminker
Project Engineering Supervisor: Emil Ruhman

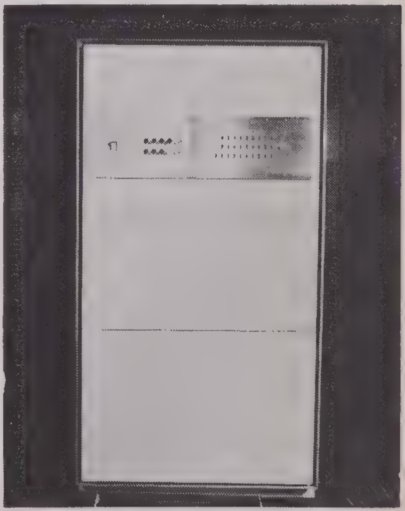


General Electric Co., Light Military Electronics Dept.

Ballistic Missile Compute Depot Test Set

Injects programmed problems into missile computer and checks answers with programmed answers

Design Director:
George A. Beck, FIDI
Designer:
Ernest V. Hansberry
Project Engineering Supervisor:
George H. Siegel



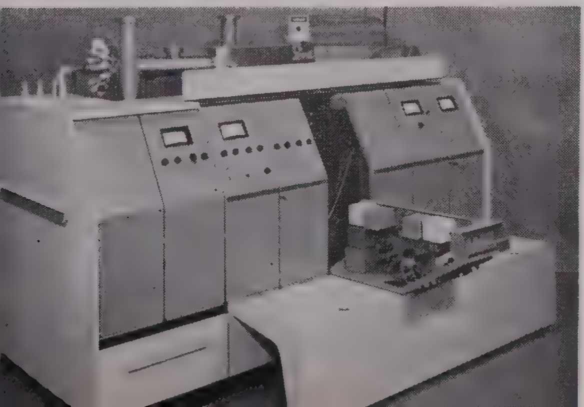
Consolidated Electrodynamics Corp., Analytical & Control Div.

36 Sierra Madre Villa, Pasadena, Calif.

Mass Spectrometer

Instrument for detection of trace impurities in solids and structural determination of complex molecules

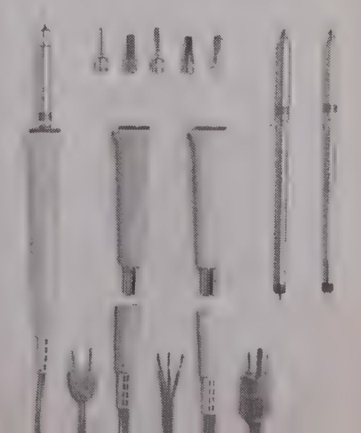
Design Director: Andrew Nowina-Sapinski
Project Engineering Supervisor: Charles G. Blanchard
Associate Engineer: James B. Henderson

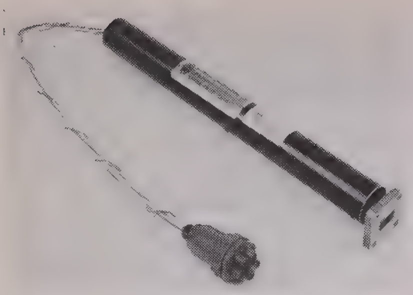


Ungar Electric Tools, Electronic Div. Eldon Industries, Inc.

Imperial® Soldering Iron

Design Director:
B. Cagan
Designers:
Al Knowles
Ervin Harvey

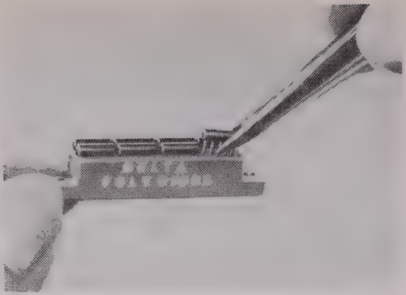




Oscillator

BWO has between 10 and 20 MW of power in a range of 15-22 GC. Model OD 15-22, offers wide-range tunability, and smooth power out vs. freq. curve. Stewart Engineering Co. BOOTH 123

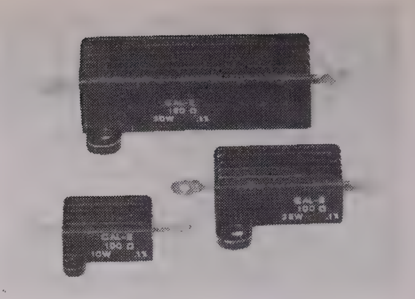
Circle 169 on Inquiry Card



Plug-in Diodes

The Poly-Diode® consists of up to 5 separate diode junctions, with individual leads on a single silicon slice in a computer gate configuration. Delta Semiconductors, Inc. BOOTH 4512

Circle 172 on Inquiry Card



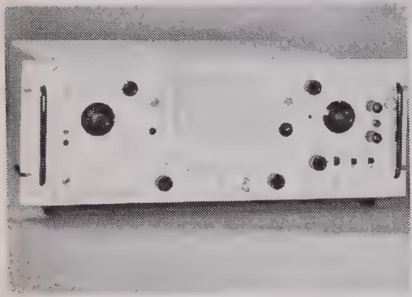
Power Resistors

Types MC (Inductive) and MCX (Non-Inductive) units mount on chassis for heat dissipation in high power heat-sink uses. Available in ratings of 10, 25 and 50 w. California Resistor Corp. BOOTH 3506

Circle 174 on Inquiry Card

Rack-Mount Oscilloscope

Type RM561 is basically an indicator which accepts a wide range of plug-in units in both channels, for use in dc to 4 MC range. Provides 85 w of power for plug-in units. Tektronix, Inc. BOOTH 1726

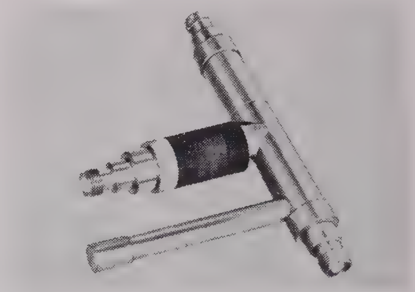


Circle 170 on Inquiry Card

See These Products At WESCON

Coaxial Crystal Mixers

The XR series, single-ended coaxial mixers cover the 225 to 600 MC region in seven overlapping freq. ranges are fixed timed, requiring no r-f adjustment over the specified freq. bands. Microlab. BOOTH 4306



Circle 175 on Inquiry Card

Humidity Chamber

Features: range, automatic cycle between 25°C-65°C (±1°C); humidity, ±1% constancy throughout complete cycle; use, performing humidity cycle of Mil-202B. Blue M. Electric Co. BOOTH 5112

Circle 171 on Inquiry Card

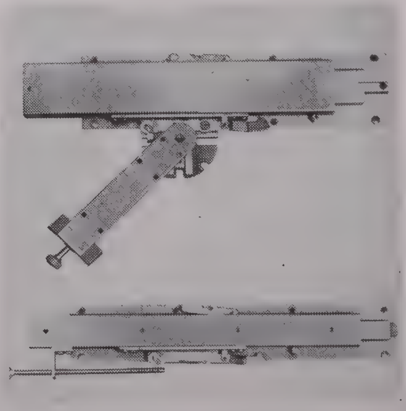
Welding System

Each PAWS-1 high production automatic system is an integrated, mobile work-station for electronic welding of microminiature components. Weldmatic Div./Unitek Corp. BOOTH 4808

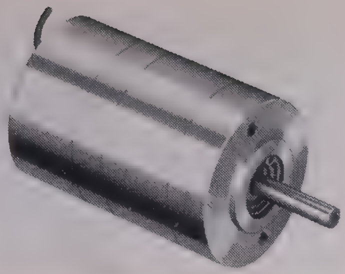
Circle 173 on Inquiry Card

Locking Device

Positive Slide Lok® eliminates locks releasing under shock and fibration testing. Can only be released manually by means of the rod release button. Sliding Mechanisms, Inc. BOOTH 4910



Circle 176 on Inquiry Card



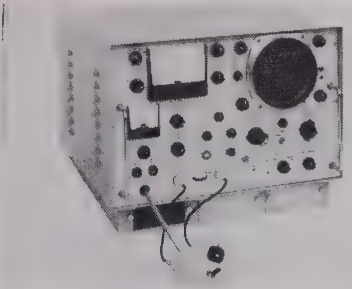
DC Motor

This HYLM permanent magnet dc motor is designed to Mill specs. One in. in dia., it features precision ball bearing and constant pressure springs to insure brush life. Barber-Colman Co. BOOTH 3601

Circle 177 on Inquiry Card

Switching Time Tester

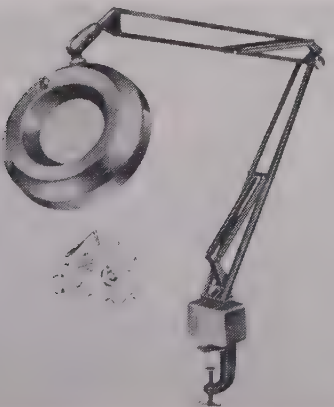
Model 205 Automatic Switching Time Test Set covers times of 1 μsec. to 1 μsec. It includes an oscilloscope having an 8 MC band width, and GO, NO-GO lights for fast checking of transistors. Wiltron Co. BOOTH 1212



Circle 178 on Inquiry Card

Illuminated Magnifier

Model LFM uses a fine Bausch & Lomb optically ground lens, with a power of 7 diopters, is illuminated by a standard 22 w. circl-line fluorescent tube providing 400 ft. candles at work level. Luxo Lamp Corp. BOOTH 308



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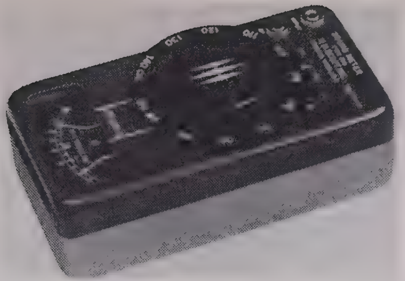


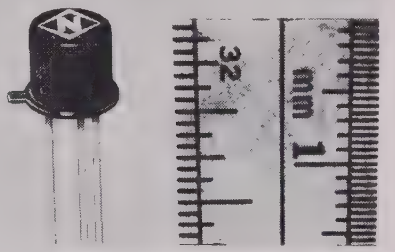
Sound Meter

Light, transistorized unit measures 2 x 3 x 6 in. Model 450 weighs 2 lbs., has a range of operation from 35-142 db sound level, and a 40-8000 CPS response. H. H. Scott, Inc. BOOTH 305

Circle 180 on Inquiry Card

Hi-Speed Switches

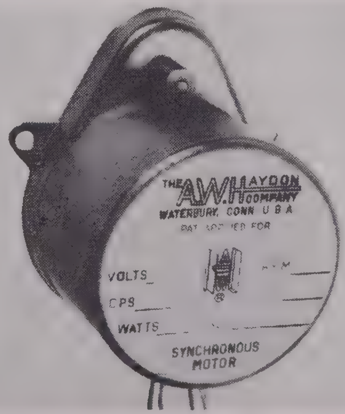
Silicon npn epitaxial transistors, TO-18 series, NS-381, NS-382, NS-383 and NS-384 feature fast switching speeds, high breakdown voltages and low saturation voltages. National Semiconductor Corp. BOOTH 4212



Circle 181 on Inquiry Card

Synchronous Motor

Series 46100 AC timing motors have no slippage, stop without coasting, and are reversible without recourse to mechanical no-back devices. Deliver 30 oz. in. torque, either direction at 1 RPM. A. W. Haydon Co. BOOTH 2802



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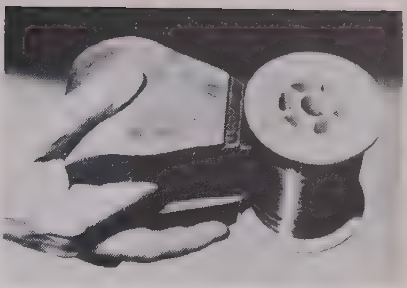


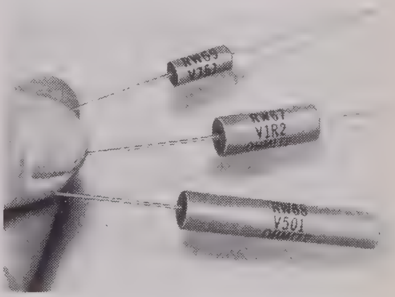
Magnet Wire

Netic®, Co-Netic® AA and Co-Netic B alloy wires with high permeability are available in flat or round wire size from 3 to 40 AWG. Magnetic Shield Div., Perfection Mica Co. BOOTH 4606

Circle 183 on Inquiry Card

Insulated Resistors

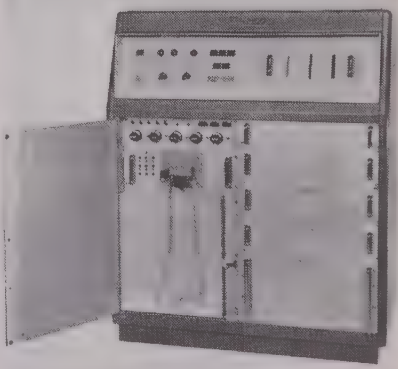
Styles RW67, 68 and 69, pass Mil-R-26C, Amendment 2. A thick, molded silicone-ceramic jacket protects these molded, wire-wound, axial-lead resistors. Temp. coefficient is 20 ppm/°C. Ohmite Mfg. Co. BOOTH 1601



Circle 184 on Inquiry Card

Logic Circuit Tester

Tape Programmed Model 720, Automatic Logic Circuit Tester, checks and evaluates characteristics of packaged modular circuits. Measures voltages, resistances, and currents on a "hi-go-lo" basis. Dit-Mco, Inc. BOOTH 2625



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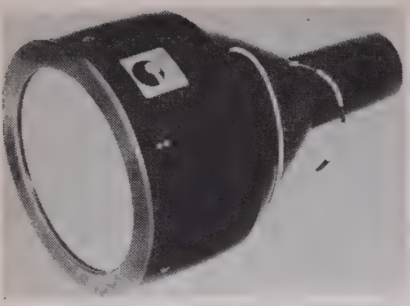
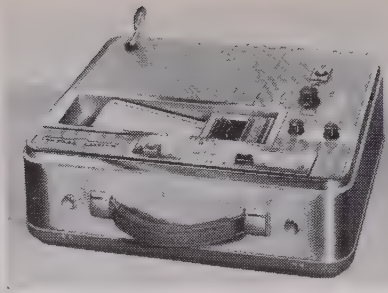


Storage Tubes

Multi-mode Tonotron® tube, Model H-1059, with 10 in. flat view screen is a direct viewing storage tube having selective erasure, high resolution and write-through capabilities. Hughes Aircraft Co./VTP Div. BOOTH 3106

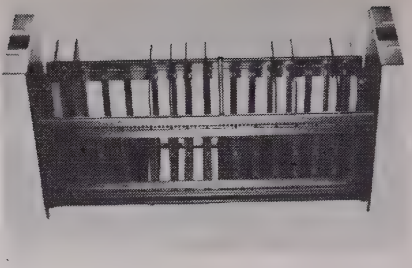
Circle 186 on Inquiry Card



Direct Writing Recorder

Tracemaster® single-channel units are completely self-contained and weigh 20 lbs. They accommodate 200 ft. of chart, are push-button controlled, to speeds of 1, 5, 20, and 100 mm/sec. American Optical Co. BOOTH 3709

Circle 189 on Inquiry Card



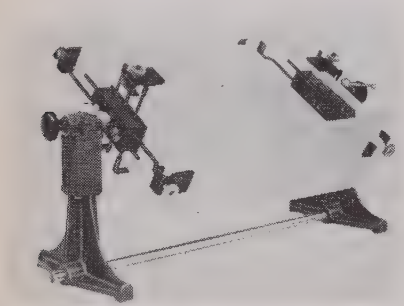
Card Enclosure

Varipak II printed circuit card enclosure is for adaption to any packaging using printed or etched circuitry, to provide max. density. Guides are polycarbonate plastic rated 280°-300°F. Elco Corp. BOOTH 2124

Circle 191 on Inquiry Card

Chassis Fixture

"TD Model A," rotates, positions and transports electronic chassis for assembly, test and service. Includes: adjustable spindle height, and 8 point fast action clamping. Technical Devices Co. BOOTH 4802

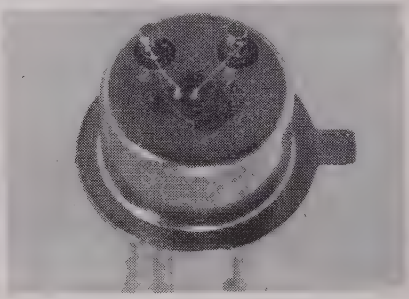


Circle 187 on Inquiry Card

See These Products At WESCON

High Voltage Switch

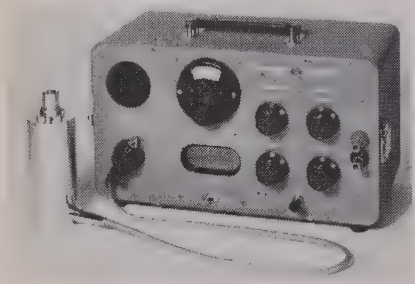
High speed, double diffused epitaxial silicon mesa transistors are primarily for core driver and other high current, high voltage uses. Dissipate 2 w total power at 25°C. Philco Corp., Lansdale Div. BOOTH 919



Circle 192 on Inquiry Card

HF Transfer Voltmeter

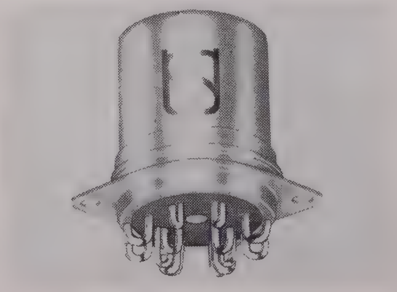
Model 393 is a transfer device for measuring an unknown ac voltage in terms of a dc voltage. Transfer impedance of probe is uniform from 25 CPS to 30 MC. Ballantine Laboratories, Inc. BOOTH 2501



Circle 188 on Inquiry Card

Miniature Relay

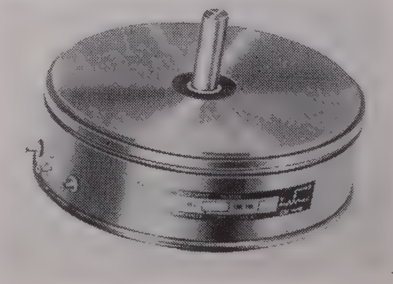
Hermetically sealed rotary-type relay meets Mil-R-6106, Mil-R-5757D and Mil-R-25018. Weight, 3¾ oz. in the standard case. Union Switch & Signal Div., Westinghouse Air Brake Co. BOOTH 3101



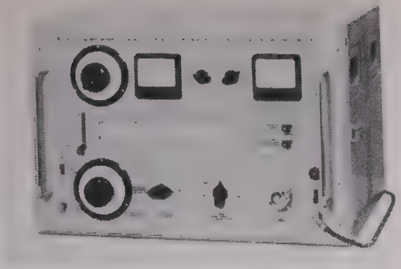
Circle 190 on Inquiry Card

Potentiometers

Borg 2490 Series Micropot® units are 3 in. dia., single-turn, wire wound, ranging from 100 to 200,000 Ω. Gangable up to 8 units. Borg Equipment Div., Amphenol - Borg Electronics Corp. BOOTH 3411



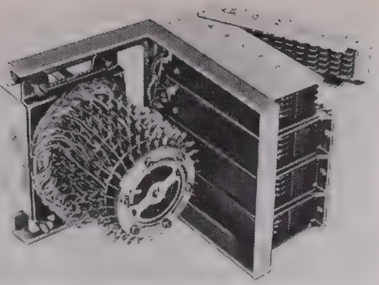
Circle 193 on Inquiry Card



Signal Generator

Power Signal Generator, Type SLRD, has an increased freq. range of 275 to 3000 MC. It features 20 w max. output, calibrated output meter and direct-reading freq. scale. Rohde & Schwarz Sales Co., Inc. BOOTH 2526

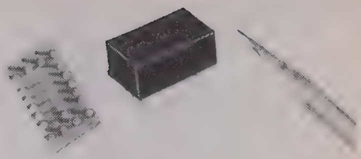
Circle 194 on Inquiry Card



Plug-in Stepping Switch

Rotary Stepping Switch comes completely wired to plug-in connectors in a 6 5/16 by 6 by 4 9/16 in. unit. Features bridging type wipers. Unit provides 240 individual connections. North Electric Co., Electronetics Div. BOOTH 2502

Circle 197 on Inquiry Card



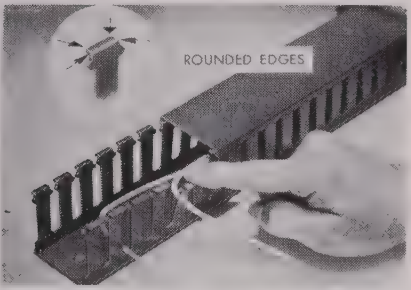
Micro-Modules

Micro-electronic BIPCO$^{T.M.}$ Modules convert binary coded decimal information to decimal form. The BIP-5501 converts the 1224 code and BIP-5502 accepts the 1248 code. Electronic Components Div., Burroughs Corp. BOOTH 2507

Circle 200 on Inquiry Card

Plastic Wiring Duct

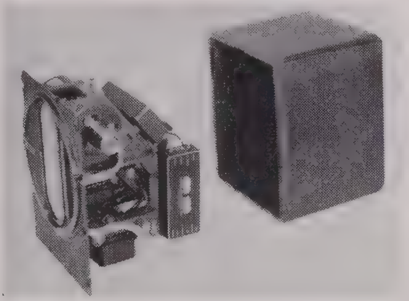
This open-slot plastic wiring duct in 25 different sizes incorporates rounded top surfaces on the duct. This protects wire insulation and prevents irritation of the installer's hands. Panduit Corp. BOOTH 817



Circle 195 on Inquiry Card

Horizon Sensors

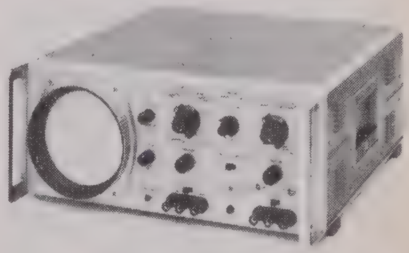
Provides precision vertical reference and altitude measurement for space vehicles; will automatically search for, lock on and track thermal horizons. Barnes Engineering Co. BOOTH 1308



Circle 198 on Inquiry Card

Oscilloscope

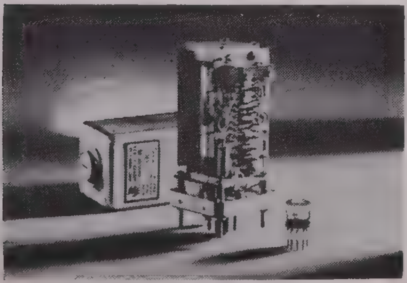
Model 120B is a 200 KC triggered oscilloscope using a new CRT with internal graticule to eliminate parallax error. It features direct reading calibration. Hewlett-Packard Co. BOOTH 2313



Circle 201 on Inquiry Card

Frequency Standard

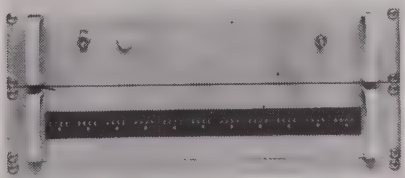
JKTO-42 Frequency Standard is a compact, plug-in transistorized oscillator with a stability of 5 x 10^{-9}/day. It is a low-drive-level, current limiting device. James Knights Co. BOOTH 1509.



Circle 196 on Inquiry Card

Fault Counters

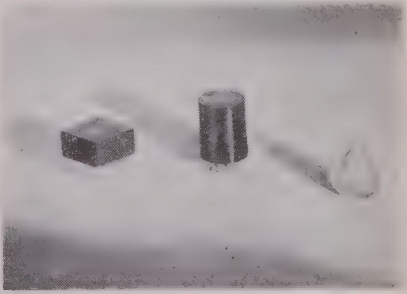
Transistor Fault Counters operate in various modes to display fault count distribution for transistors under test. Uses include production testing, and reliability analysis. Optimized Devices, Inc. BOOTH 1210



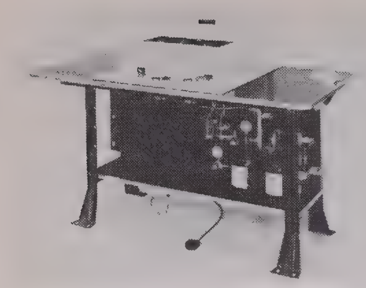
Circle 199 on Inquiry Card

NOR Circuit Modules

U-Series Universal NOR Circuits operate from 0 to 25 KC and meet Mil-STD-202B, as modified by the temp. spec. of individual units. Are encapsulated with self leads. Engineered Electronics Co. BOOTH 2320



Circle 202 on Inquiry Card



Parts Cleaner

Precision Parts Cleaner, Model RT-S-8-6, cleans switches, relays, choppers, and semiconductors at 600 units/hr., by successive high velocity spray-clean operations. Cobehn, Inc. BOOTH 4824

Circle 203 on Inquiry Card

Gain Instrument

Gain Set Model 625-A is for use in measuring gain, loss, noise figure and other transmission characteristics of systems in the UHF, VHF and microwave regions. Kay Electric Co. BOOTH 3105

Circle 206 on Inquiry Card

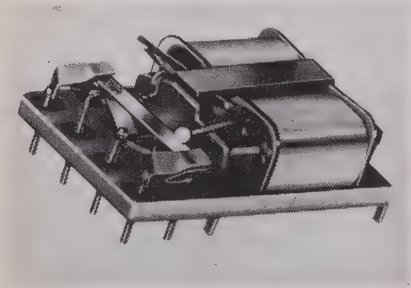
Size 8 Servo Motor

Servo has stall torque of 0.33 oz. in. min. and an acceleration of 98,000 radiens/sec^2. Response (time constant) is 0.0069. No load speed is 6200 rpm min. Wright Machinery Co. BOOTH 3717

Circle 208 on Inquiry Card

Microminiature Relay

Unit has a seated height of 0.45 in. The BR-12P is suited for printed circuit board use, where component height is limited. Babcock Relays, Div. Babcock Electronics Corp. BOOTH 312

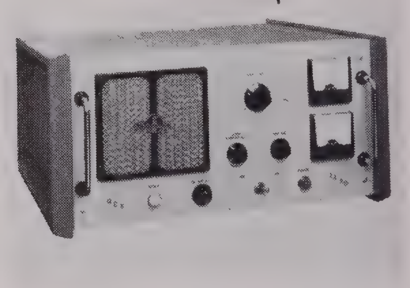


Circle 204 on Inquiry Card

See These Products At WESCON

Power Supply

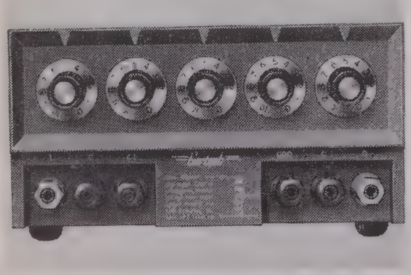
Completely transistorized Sorensen QCR 36-30 features an output up to 36 v. Regulation of ±0.01% +1 mv and reduced ripple of 0.5 mv RMS max. Includes remote programming. Raytheon Co. BOOTH 3404



Circle 209 on Inquiry Card

Ratio Transformer

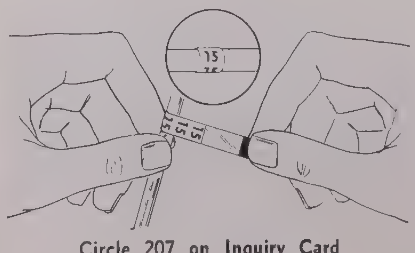
General Purpose Ratio Transformer, RT-60, measures 3½ in. high. It is an inductive ac voltage divider featuring high input impedance, low effective series impedance, and low phase shift. Gertsch Products, Inc. BOOTH 1602



Circle 205 on Inquiry Card

Wire Marker

E-Z Code® self-Laminating Wire Markers resist conventional oils, greases, chemicals, and fluids. Are self-adhering, partly transparent markers. Westline Products, Div. of Western Lithograph Co. BOOTH 4807



Circle 207 on Inquiry Card

FM Signal Generator

Model 1001 continuously tunable from 400 to 550 MC, has a freq. drift of 0.015%/hr. Dial calibration accuracy is ±0.5%. Three plug-in oscillators have an accuracy of ±0.01%. R S Electronics Corp. BOOTH 3322

Circle 210 on Inquiry Card

Latest Western Literature for Engineers

Data Sheet Study

"How to get More Value Out of a Transistor Data Sheet," is available from Motorola Semiconductor Products, Inc., 5005 East McDowell Rd Phoenix, Ariz. Subjects covered include: distinction between ratings and characteristics; explanations of transistor characteristics; and a transistor circuit design check list. Graphs and tables included.

Circle 211 on Inquiry Card

Temp. Transducers

Microdot Inc., 220 Pasadena Ave., South Pasadena, Calif., has tech. data available on Microminiature Coaxial Connectors, Microminiature Coaxial Cables, Temperature Transducers and Airborne VHF-UHF Transmitters & Cavities. Photographs, line drawings, and specs. are included.

Circle 212 on Inquiry Card

Magnetic Tape Heads

Photographs, dimensional drawings and complete specs. cover 10 different types of Magnetic Heads and Drum Systems. Magne-Head Div., General Instrument Corp., 3216 West El Segundo Blvd., Hawthorne, Calif.

Circle 213 on Inquiry Card

Wireless Microphone

Tech. data is available from Vega Electronics Corp., Cupertino, Calif. on their Vega-Mike® wireless microphone. This mike is completely self contained (Microphone-transmitter-FM-and battery supply).

Circle 214 on Inquiry Card

Cable Catalog

Standard Wire & Cable Co., 3440 Overland Ave., Los Angeles 34, Calif., has available a tech. brochure on Special Cables and Wires, IPCEA, and Commercial Types, Electrical Wire Cord & Cable, UL Types, and Wire & Cable to Military Specs.

Circle 215 on Inquiry Card

Capacitors

Hopkins Engineering Co., 12900 Foothill Blvd., San Fernando, Calif., has tech. information available on "Sub-Miniature Capacitors." Capacitors covered are Mylar, Metallized Mylar, Polystyrene, Metallized Paper, Hy-Therm, and Bathtub Type.

Circle 216 on Inquiry Card

Optical Facilities

Ball Brothers Research Corp., Boulder, Colo., has a facilities brochure available covering their Optical Laboratory, Servo and Electronics Laboratories, Television and Telemetry Laboratories and other instrumentation facilities. Photographs and brief descriptions included.

Circle 217 on Inquiry Card

Tube Catalog

Litton Industries, Electron Tube Div., 960 Industrial Rd., San Carlos, Calif., is offering their Electron Tube Condensed Catalog for 1961. Photographs and complete spec. cover, magnetrons, Microtron, m-type BWO, crossedfield FW amplifier tubes, switch tubes, focus coils and accessories, TWT's, and millimeter wave tubes.

Circle 218 on Inquiry Card

Patchboard

Vector Electronic Co., Inc., 1100 Flower St., Glendale 1, Calif., has tech. data available on their new Preprogramming Patchboards. Sizes include 200, 300, 450, and 600 contacts, and multiples of 600 contacts. Patchboards may be mounted either vertically or horizontally.

Circle 219 on Inquiry Card

Recorder/Reproducer

Tech. Bulletin 2600, describes VR-2600 Wide-Band Magnetic Tape Recorder/Reproducer. This integrated multichannel wide-band data, recording and reproducing system is designed to handle precision data in a freq. spectrum from d-c to 500kc. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Circle 220 on Inquiry Card

Epoxy Compounds

Tech. data is available from American-Marietta Co., Adhesive, Resin & Chemical Div., 3400 13th Ave., S.W., Seattle, Wash., on their EMC 90 Series epoxy molding compounds. Information includes, molding characteristics, physical properties, storage life, electrical properties, applications, and types & color available.

Circle 221 on Inquiry Card

Fasteners

"What You Should Know About Stand-off Fasteners," is available from Western Sky Industries, 21301 Cloud Way, Hayward, Calif. Sections covered include, Advantages and Disadvantages of each Type, Causes of Failure of Stand-off Fasteners, How

Circle 222 on Inquiry Card

Ceramics

Electro-Ceramics Inc., 2645 South 2nd West, Salt Lake City 15, Utah, has tech. data available on "Transducers, Piezoelectric Materials"; "High Alumina Ceramics"; "Metalized Ceramics"; "High Alumina Custom Shapes"; and "91-96-99% Alumina Vessels."

Circle 223 on Inquiry Card

Semiconductors

Hughes Aircraft Co., Semiconductor Div., 500 Superior Ave., Newport Beach, Calif., has tech. information available covering the following subjects: Semiconductor — Short Form Catalog; Why Engineers Use Germanium Diodes; Silicon Alloy Diodes —Reliability by Design; Microseal Components; Packaged Assemblies; and Cast Silicon and Germanium Components for Infrared Optics.

Circle 224 on Inquiry Card

Intercom

Fisher Berkley Corporation, 1475 Powell St., Emeryville 8, Calif., has available a 30 page manual on their Ektacom® and Bennett® intercom equipment. Complete specs. show how to obtain max. flexibility. Diagrams and schematics are included.

Circle 225 on Inquiry Card

Recording Equipment

Bach Auricon, Inc., 6950 Roamine St., Hollywood 38, Calif., has tech. data available on their "Pro-600 Special" 16mm "Double-System" & "Single-System" Sound Camera. Also included is information on their All-Transistorized "Filmagnetic" 16mm "Single-System" Magnetic Sound-Recording Equipment for use with Pre-Striped Film.

Circle 226 on Inquiry Card

Passive Repeaters

Brochure, 48 pages, entitled "Passive Repeater Engineering Manual" No. 161, is for microwave systems engineers and others concerned with application of passive repeaters. Manual describes in detail, use of passive repeaters and provides tech. data necessary to design passives into microwave systems. Cost $1.50 from Microflect Co., Inc., 3540 25th St. S.E., Salem, Ore.

Circle 227 on Inquiry Card

Recorders

Precision Instrument Co., 1011 Commercial St., San Carlos, Calif., has tech. data available on their Minitel Discriminator, Test and Calibration Units, Switch Box/Meter Panel, and PS Series Recorders.

Circle 228 on Inquiry Card

R-F Calibration Test Set

Sierra Electronic Corp., Div. Philco Corp., 3885 Bohannon Dr., Menlo Park, Calif., has tech. data available on their Frequency Selective Voltmeter, Model 125B-Y, Model 125B-CR, Coaxial Water Load, Model 186B, and their RF Calibration Test Set, Model 1223.

Circle 229 on Inquiry Card

Latest Western Literature for Engineers

Transistor Data

Zeus Engineering Co., Inc., 625 South Kingsley Dr., Suite 1, Los Angeles 5, Calif., has available a 74 page manual containing reference material on currently available domestic transistors. Material includes manufacturer's information, comprehensive Cross-Index listing transistors in numerical sequence indicating type and manufacture, and a section on commercial and military-approved transistors. The manual, including quarterly revisions, $5.00 per year.

Circle 230 on Inquiry Card

Power Supplies

Christie Electric Corp., Dept. C., 3410 West 67th St., Los Angeles 43, Calif., has available Bulletin AC-60-1, describing their line of Rectifier Power Supplies in dc voltage ranges up to 135 v, with capacities from 15 to 1500 a. Also available is Bulletin BC-60-1 which describes their Automatic Battery Chargers.

Circle 231 on Inquiry Card

Trimming Pots

Con-Elco Div., Edcliff Instruments, 1711 S. Mountain Ave., Monrovia, Calif., has a tech. bulletin describing their 027 Series of subminiature slide wire trimming potentiometers and variable resistors. Electrical, environmental and mechanical specs. are detailed.

Circle 232 on Inquiry Card

Systems Capabilities

American Systems, Inc., 1625 E. 126th St., Hawthorne, Calif., is offering a tech. brochure listing their capabilities and facilities in thin-film research, computer programming, exotic propellant senors, and audio-visual devices. Included are spec. and photographs.

Circle 233 on Inquiry Card

Pulse Code Generator

Exact Electronics, Inc., P.O. Box 234, Hillsboro, Ore., is offering tech. data on their Type C Variable Width Plug In Pulse Code Generator, and Type F Variable Slope Plug In Complex Waveform. Photographs, waveform pictures and complete specs. are included.

Circle 234 on Inquiry Card

High Voltage Components

Components For Research, Inc., 979 Commercial St., Palo Alto, Calif., has a brochure available on High Voltage Epoxy Resin Insulators, Feedthrough Bushings, Very-High-Voltage Coax Terminations, and Hermetic-Seal Feed-through Bushings. Photographs, specs and line drawings are included.

Circle 235 on Inquiry Card

Reflector Antennas

WDL-TR-1500 entitled, "Reflector Antennas for Radio and Radar Astronomy," is available from Philco Corp., Western Development Labs., 3875 Fabian Way, Palo Alto, Calif. The 91 page booklet is the result of a world-wide survey of electro-mechanical data on reflector type radio telescopes. Data is tabulated according to country and operating radio observatory, for each antenna in order of increasing physical cross-sectional area above ten square meters. An extensive list of references is included.

Circle 236 on Inquiry Card

Power Supplies

Short-form catalog includes standard TP and modular series transistorized power supplies. Photographs, charts and descriptions are included. Catalog 401, from Invar Electronics Corp., 1723 Cloverfield Blvd., Santa Monica, Calif.

Circle 237 on Inquiry Card

Insulators

Coors Porcelain Co., 600 Ninth St., Golden, Colo., has a 22 page brochure available on Ceramic Insulators. Subjects covered in the booklet are: How Ceramic-to-Metal Seals are Made, Mechanical and Electrical Properties of High Strength Alumina Ceramics and information on Coors "B," "C," "D," Line Standard Terminal Insulators. Photographs, line drawings and specs are included.

Circle 238 on Inquiry Card

Laminates

Synthane Corp., Oaks, Pa., has tech. data available on flame-retardant laminated plastics. Information covers flame-retardant Grades FR-1, FR-2, FR-3, and FR-4. Data is also available on G-10, G-11 (glass-base epoxies) and Grades XXP, XXXP, XXXP-1R, and XXXP-C (paper-base laminates).

Circle 239 on Inquiry Card

Powder Iron Cores

Magnetic Core Corp., P. O. Box 368, Newburgh, N. Y., has available a brochure entitled "Proper Core Selection." The information is based on electronic powder comparisons and electro-magnetic characteristics. Descriptions of the various types cores available, complete specs and price lists are included.

Circle 240 on Inquiry Card

Components Catalog

Ohmite Manufacturing Co., 3601 Howard St., Skokie, Ill., has available a catalog 50B, covering, fixed power resistors, adjustable power resistors, power rheostats, relays, and diodes. All components are for Military uses.

Circle 241 on Inquiry Card

Rectifier Stacks

International Rectifier Corp., El Segundo, Calif., has tech. data available on their Selenium Rectifier Stacks, Standard and High Voltage, Double & Triple Density types. Bulletin SR-170 contains information on rectifier circuits, coding, performance characteristics and design data.

Circle 242 on Inquiry Card

Toroidal Core Design

Connolly & Co., P. O. Box 295, Menlo Park, Calif., has available "Genalex Toriodal Core Design Handbook," containing basic design information tips and formulas. Included are temp. curves, analysis of core loss, dc resistance, eddy current loss resistance, hysteresis loss resistance and self-capacitance.

Circle 243 on Inquiry Card

Components Handbook

North Electric Co., Electronics Div., Galion, Ohio, has available a comprehensive "Components Handbook" for electronic and electrical design engineers. The 150 page handbook covers relays and switch terminology and theory, switching and control circuits, plus helpful reference, application and technical data. Copies normally priced $2.00, $1.00 at WESCON.

Circle 244 on Inquiry Card

Automatic Soldering

Tech. information is available from Special Products Div., Compo Shoe Machinery Corp., 125 Roberts Rd., Waltham 54, Mass., on their Adawave® Wave and Jet Soldering systems. The brochure contains photographs, tables of specifications, and drawings.

Circle 245 on Inquiry Card

Conductive Cements

Tech. bulletin, "Ceramic Products" CP 7-361, is available from the E. I. Du Pont Nemours & Company (Inc.), Wilmington 98, Del., on Conductive Cements. Topics covered are Thermosetting Silver Cements, Applying and Curing Cements, Silver Cement in Laminations, and Testing Procedures. Physical property table and specs. are included.

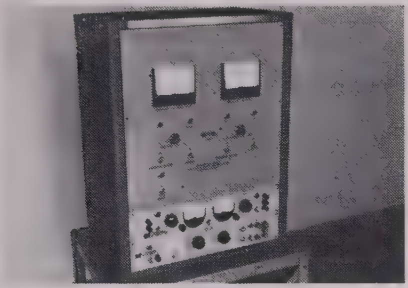
Circle 246 on Inquiry Card

Potentiometers

Catalog on "Precision Wire-Wound Potentiometers" gives descriptions, complete tech. specs., dimensional drawings and photographs of 11 different series of pots and their military versions. Included are Single-Turn Vari/Phase, Multi-Turn, Single Turn, and Padohm Trimming Type Potentiometers. Clarostat Mfg. Co., Inc., Dover, New Hampshire.

Circle 247 on Inquiry Card

See These Products At WESCON



Component Tester

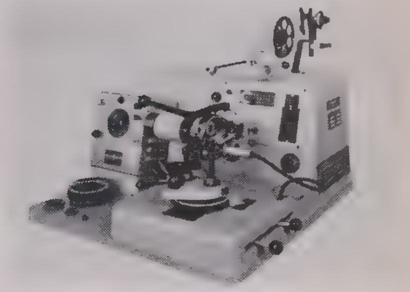
Model SSTD-1 is for high speed, automatic testing of diodes. The comparators are highly stable, fast time response, chopper input ac amplifiers. Universal Instruments Corp. BOOTH 4932

Circle 248 on Inquiry Card

Subminiature Relay

This Micro-Mite® SPDT 2 a. hermetically sealed military relay weighs under 0.017 oz., is housed in a compact 0.275 in. dia. tube, under 0.900 in. long. Electro-Mechanical Specialties Co. BOOTH 1422

Circle 249 on Inquiry Card



Coil Winding Machine

Model LS-1, toroidal coil machine with 360° roller table winds #20-46 wire, 0-1200 rpm and down to 0.065 in. finished inside dia. It features "floating" coil centering. Universal Mfg. Co., Inc. BOOTH 4532

Circle 252 on Inquiry Card

Tech Papers

(Continued from page 123)

"The Use Of Quasi-Static Mode Approximations In The Design Of Broadband, Slow-Wave Structure Impedance Matches," W. Raub.
"A 50-Microwatt BWO And 0.5 Watt TWT For CW Operation At 50-60 KMC," D. O. Melroy.

NONLINEAR CONTROL SYSTEM THEORY

Chairman: Prof. E. I. Jury, University of Calif.
"On The Application Of Lyapunov's Second Method To The Synthesis Of Nonlinear Control Systems," A. Stubberud, C. T. Leondes and M. Margolis.
"Mathematical Analysis Of Automatic Gain Control Circuits," R. C. Davis.
"Dual Mode Filtering Of Polynomial Signals In Noise," L. G. Shaw.

SPECTRUM UTILIZATION FOR SPACE COMMUNICATIONS

Chairman: Jobe Jenkins, Lockheed Aircraft Corp.
"Impact Of Space Communication On The Spectrum," J. Hacke, Jr.
"Interference Considerations For Communications Satellites," N. Berger, J. Downing, F. Fulton and D. Harris.
"Channel Utilization By Intermittent Transmitters," F. Fulton, Jr.

QUANTUM DEVICES

Chairman: Prof. A. E. Siegman, Stanford University.
"Design And Operation Of An Experimental Colidar," E. J. Woodbury, J. M. Morse, R. S. Congleton and M. L. Stitch.
"A Solid State Spin Echo Memory System For A Microwave Digital Computer," L. K. Wanlass and J. R. Singer.
"The Ammonia Beam Maser As A Standard Of Frequency," J. A. Barnes, D. W. Allan and A. E. Wainwright.

Fri., Aug. 25—A.M. Sessions

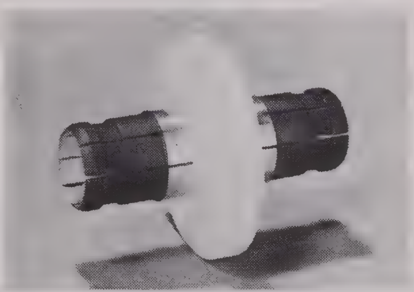
PROPAGATION STUDIES FOR NEW COMMUNICATIONS TECHNIQUES

Chairman: Prof. Von R. Eshleman, Stanford University.
"Laboratory Simulation Of VLF Propagation And Underground Antenna Performance," T. C. Larter, M. E. Loupre and A. Stogryn.
"Synchronized-Oblique Ionosphere Sounding For H-F OWF Determination," R. D. Baker, R. D. Egan and L. D. Seader.
"Free Electron Scatter As A Communication Mode," A. M. Peterson.

(Continued on page 134)

Coaxial Connector

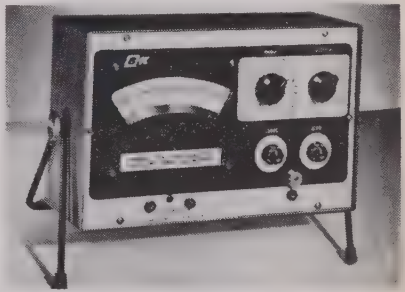
Lubricated coaxial transmission line anchor insulator connector, assures the elimination of galling on bullet type inner conductor connector contact surfaces. Prodelin, Inc. BOOTH 2701



Circle 250 on Inquiry Card

Direct-Reading VTVM

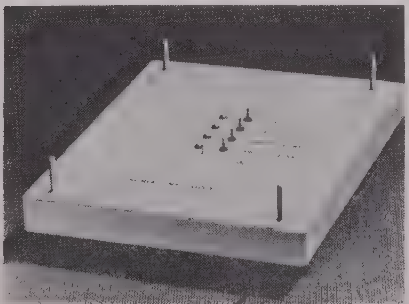
Dynamatic® 375 automatic VTVM provides quick direct, error-free readings without multiplying. Individual wide-view scale for each range, all scales are direct reading. B&K Mfg. Co. BOOTH 4122



Circle 253 on Inquiry Card

Delay Lines

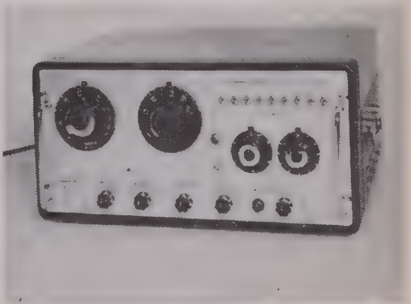
Magnetostrictive units feature longer delays in smaller sizes, and increased temp. operating ranges. Adjustable time and multiple output lab. models also available. Deltime, Inc. BOOTH 714



Circle 251 on Inquiry Card

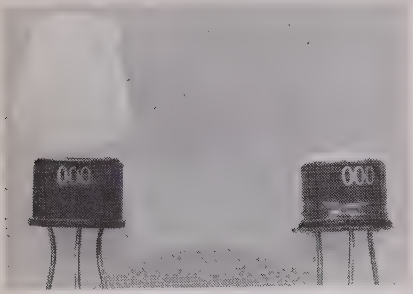
Sweep-Signal Generator

Model MS-2000 features: Plug-in heads, audio to 3000 MC; functions include, sweep-mod. sweep, cw-mod. cw; and ±0.05 db flatness with ext. monitor. Telonic Industries, Inc. BOOTH 3813



Circle 254 on Inquiry Card

See These Products At WESCON



Transistor Insulation

Diode and transistor cases are insulated by using pre-formed Thermofit® heat shrinkable sleeving. Used where there is a voltage on case. RayClad Tubes, Inc. BOOTH 5008

Circle 255 on Inquiry Card

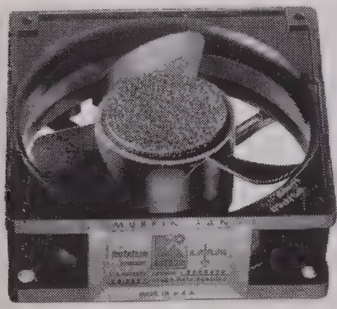
Transformer Line

Linear Voltage Differential Transformers, 26 v., 400 CPS units are offered in a variety of sizes and shaft lengths. Helipot Div., Beckman Instruments, Inc. BOOTH 2002

Circle 258 on Inquiry Card

Fan

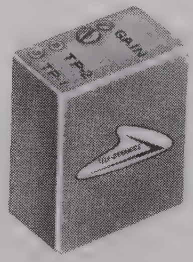
Gold Seal Muffin® fan moves 100 cfm under free delivery conditions on 110 vac and is available as a skeleton, venturi, grilled, or filtered fan. Rotron Mfg. Co., Inc. BOOTH 3006



Circle 256 on Inquiry Card

Wideband Amplifier

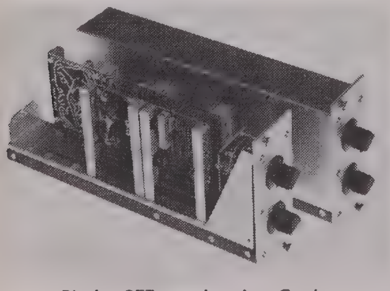
Type 1170 transistorized unit is for amplifying the mixed signal outputs of a group of subcarrier oscillators. Tele-Dynamics Div., American Bosch Arma Corp. BOOTH 4126



Circle 259 on Inquiry Card

Instruments

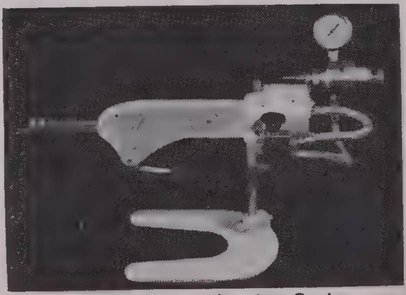
Completely solid state, the 1800 Series, using standard sub-modules provides a variety of gain ranges, gain steps, freq. responses and outputs. Burr-Brown Research Corp. BOOTH 3320



Circle 257 on Inquiry Card

Pneumatic Banding Tool

Core loop banding tool features band tension uniformity, and immediate change of tension for any size or configuration of loops and/or banding material. Thomas & Skinner, Inc. BOOTH 1819



Circle 260 on Inquiry Card

Tech Papers

(Continued from page 133)

SOLID STATE DEVICES II

Chairman: Gordon Moore, Fairchild Semiconductor Corp.

"P-N Junction Charge Storage Diodes," J. L. Moll, S. Krakauer and R. Shen.

"A New Semiconductor Tetrode, The Surface-Potential Controlled Transistor," C. T. Sah.

"P-N-P Doubled Diffused Germanium Switch," J. Brixey and W. Jaeger.

MODERN PARTICLE ACCELERATORS

Chairman: Harry G. Heard, Radiation At Stanford.

"The R. F. Systems For The Princeton Pennsylvania Accelerator," D. A. Barge, J. Kirchgessner, G. K. O'Neill, G. Rees, and J. Reidel.

"Beam Capture And Acceleration In The Brookhaven Alternating Gradient Synchrotron," Martin Plotkin, E. C. Raka, H. Hahn, and H. Halama.

"The Zero Gradient High Intensity Protron Synchrotron," A. V. Crewe.

CODING FOR RELIABILITY

Chairman: Bernard Elspas, Stanford Research Institute.

"On Time-Varying Coding Networks," A. Marcovitz.

"Sequential Decoding For Discrete Input Memoryless Channels," B. Reiffen.

"The Reliability Of Coded And Uncoded Binary Messages As A Function Of The Rate Of Symbol Transmission," R. D. Klein.

NEW TECHNIQUES TO EVALUATE PRODUCT DESIGN

Chairman: Hugh D. Kennedy, Granger Assoc.

"Rank Correlation Testing Applied To Product Design," I. R. Whiteman.

"A Survey Of Applications Of Radioactivity To Electronics," A. J. Moses.

"Optimized Use Of Industrial Design Technique," Donald J. McFarland.

Fri., Aug. 25—P.M. Sessions

NEW DEVELOPMENTS IN COMMUNICATIONS SYSTEMS

Chairman: Alan F. Culbertson, Lenkurt Electric Co., Inc.

"The HC-270—A Four Phase Digital Data Transceiver," J. E. Toffler and J. N. Buterbaugh.

"High Speed Serial Data Over Parallel, Low Speed H. F. Radio Links Via Sepath," C. S. Krakauer.

"Dependency Of Cross-talk On Upper And Lower Cutoff Frequencies In Pam Time-Multi-Plexed Transmission Paths," H. M. Straube.

ULTRASONIC AIDS TO THE MILITARY & INDUSTRY

Chairman: Gilbert G. Brown, Amsco Electronics Co.

"A Method For Non-Destructive Evaluation Of Physical Properties In Rubber-Solid Compounds," J. G. Martner.

"Evaluating Sonic Energy Cleaning," Dr. Thomas Bulat.

"The Effects Of Bonding And Backing Materials On The Characteristics Of Ultrasonic Delay Lines," W. Konig, L. Lambert and D. Schilling.

COMPUTER THEORY

Chairman: Richard I. Tanaka, Lockheed Missiles and Space Div., Calif.

"A Decision Theoretic Approach To Machine Learning And Pattern Recognition," David Braverman.

"Diode And Transistor Logic In Synthesis Of Symmetric Boolean Matrices," H. K. Cooper.

"Logical Synthesis Of Unit-Time Arithmetic Circuitry, Burton Singer.

IDENTITY AND USE OF OPERATOR CHARACTERISTICS IN ELECTRONIC SYSTEMS

Chairman: Richard S. Hirsch, I.B.M., San Jose, Calif.

"The Concept Of 'Equalizing Ability' In Operator Selection And Training," H. P. Birmingham and R. Chernikoff.

"Isolation Of Human Performance Variables In An Operational Man-Computer System," M. M. Okanes.

"Decision-Making In Problems Utilizing Inductive And Deductive Interference," H. C. Ratz and G. H. M. Thomas.

MICROWAVE SOLID STATE DEVICES

Chairman: Philip S. Carter, Stanford Research Institute.

"An Electronically-Tunable Band-Reject Filter," K. L. Kotzebue.

"A Non-Degenerate Traveling Wave Parametric Amplifier," K. P. Grabowski.

"Magnetically-Tunable Non-Reciprocal Band Pass Filter Using Ferromagnetic Resonators," Cumar Patel.

Cinch
ELECTRONIC
COMPONENTS
®

Cinch Hinge Connectors eliminate contact damage caused by the high insertion and extraction forces encountered with ordinary multi-contact (20-100) Connectors . . . ideal for use in space-limited areas.

The exclusive Cinch Hinge Connectors are available with 20-100 contacts. Hinge Connectors are ideal for applications where a reliable multi-contact connector is needed for use in a limited area. The **ingenious Hinge and Latch principle** is foolproof and provides added reliability.

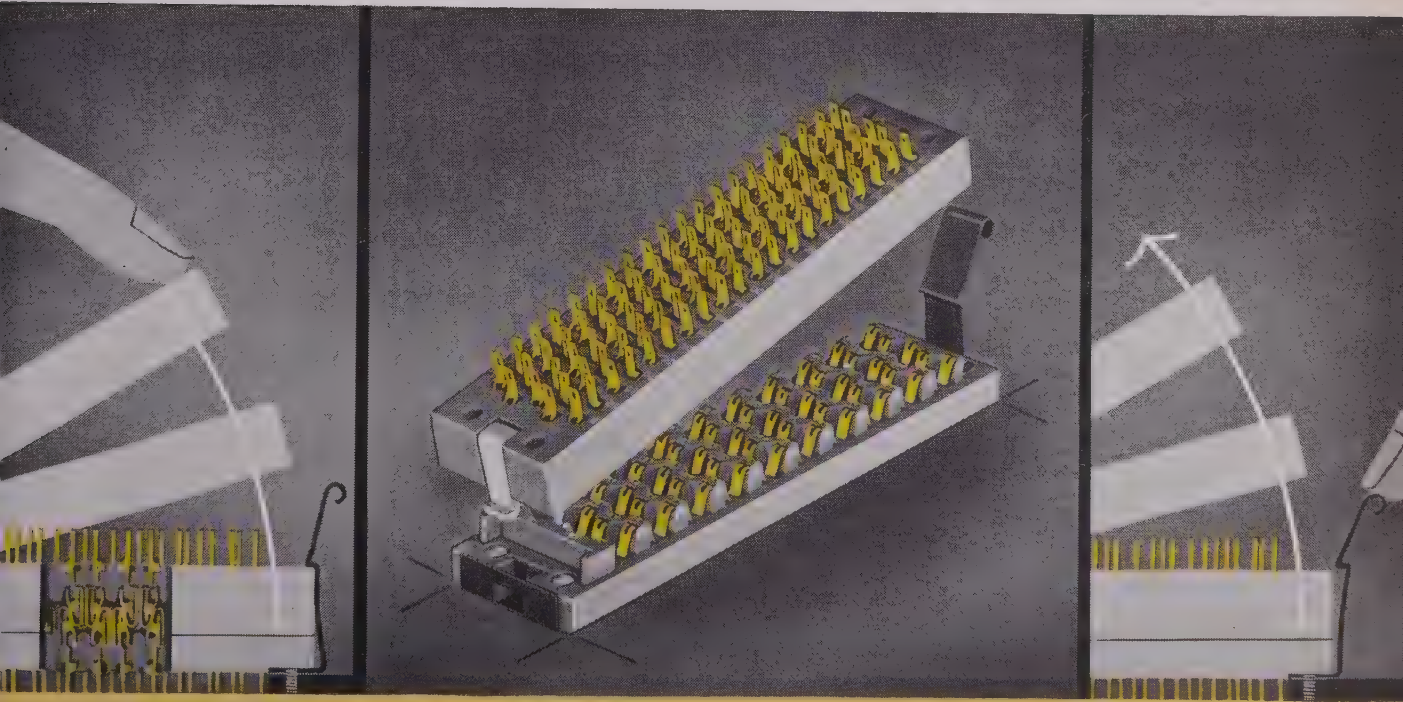
Use of this unique series of connectors eliminates damage to contacts caused by the excessive insertion and extraction forces encountered with ordinary connectors having large numbers of contacts. **Only one finger is necessary** to operate the latching device **to open and close** Cinch Hinge Connectors.

Another feature of the Cinch Hinge Connector is the design of the contacts. **Positive Contact** is always maintained because of the **pressure action** of the wiping contacts. This flexible contact design eliminates high insertion and extraction forces and provides added reliability.

In addition to the Standard Hood for use with 20-100 contact Hinge Connectors, Cinch now has a **new space-saving shallow hood** available for 20-50 contact hinge connectors. Both can be supplied with cable entry holes in top or end, with or without cable clamps and/or liners.

For further information, contact the nearest Cinch Sales Office in your area.

. . . AN INGENIOUS CONNECTOR



CINCH MANUFACTURING COMPANY
1026 South Homan Avenue, Chicago 24, Illinois
Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; City of Industry, California; St. Louis, Missouri.

Circle 70 on Inquiry Card

DOT
A DIVISION OF UNITED-CARR FASTENER CORPORATION, BOSTON, MASSACHUSETTS

New Tech Data for Engineers

Indicator Tube Catalog

Burroughs Corp., Electronic Components Div., P.O. Box 1226, Plainfield, N. J., is offering a new NIXIE® Indicator Tube Catalog, describing the new Wide Viewing Angle Series of NIXIE tubes. The Catalog covers circuit design criteria and contains detailed suggested circuits for using NIXIES in various types of electromechanical and electronic systems.

Circle 261 on Inquiry Card

Laboratory Standards

Simpson Electric Co., 5200 West Kinzie St., Chicago 44, Ill., has tech. data available on their line of laboratory standards for general industrial laboratory testing, plant incoming inspection, and production line use.

Circle 262 on Inquiry Card

Transmission Line

Catalog No. 200, entitled "Rigid Coaxial Transmission Line," is available from the Technical Appliance Corp., Sherbourne, N. Y. Catalog gives comprehensive descriptions on line of straight sections, connectors, elbows, and all hardware and accessories necessary for the installation of the system.

Circle 263 on Inquiry Card

Electro-Magnetic Clutches

New handbook is designed to assist Engineers in selecting and using electro-magnetic clutches/brakes—mechanical clutches—torque indicators—torque standards and multi-speed transmissions. Some 60 pages are included on design specs. and design assistance. Autotronics Inc., Florissant, Mo., Dept. #30. Manual #361.

Circle 264 on Inquiry Card

FM Instruments

Condensed catalog is available from Electro-Mechanical Research, Inc., Sarasota, Florida, describing their line of FM instruments and accessories for airborne telemetering. Descriptions and condensed specs. on FM subcarrier oscillators, FM mixers and amplifiers, and VHF power amplifiers and telemetry transmitters are included.

Circle 265 on Inquiry Card

Industrial Felt

Catalog features a "Ready Reference Index," alphabetically listing hundreds of uses for Industrial Felts. Included in the catalog are Price Coefficients, General Properties, Physical Properties, Mechanical Properties, Chemical Properties, and Fabricating Methods. Continental Felt Co., 22 West 15th St., New York 11, N. Y.

Circle 266 on Inquiry Card

Pressure Transducers

Norwood Bonded Strain Gage Pressure Transducers for measurement of static and dynamic pressures up to 60,000 psi, are described and illustrated in a tech. bulletin available from American-Standard, Controls Div., 5900 Trumbull Ave., Detroit 8, Mich. Bulletin #278 includes specs. and charts.

Circle 267 on Inquiry Card

Telemetry System

Alto Scientific Co., 855 Commercial St., Palo Alto, Calif., offers a tech. catalog on a UHF Telemetry Checkout Console, Analog Computer Checkout Console, Tone Generator Model G-137, L102 Series Solid State Voltage Monitors, and power supplies, filters, and broad bandwidth receivers.

Circle 268 on Inquiry Card

Copper Clad Laminates

Tech. brochure B8215, available from Westinghouse Electric Corp., Micarta Div., Hampton, S. C., gives complete information on 7 grades or types of Micarta copper clad laminates for printed circuits.

Circle 269 on Inquiry Card

Soldering Tips

Hexacon Electric Co., 157 W. Clay Ave., Roselle Park, N. J., has tech. data available on their Durotherm®, Long-Life soldering tips. Catalogs No. 650 and 601 give complete tech. information concerning diameters, lengths, shapes and tip points.

Circle 270 on Inquiry Card

Diodes

High reliability, low cost selenium dual diodes for detector and rectifier circuits are described in a tech. bulletin available from International Resistance Co., 401 N. Broad St., Phila. 8, Pa.

Circle 271 on Inquiry Card

Motors

Globe Industries, Inc., 1784 Stanley Ave., Dayton, Ohio, is offering tech data, WESCON Booth 1812: on a 2¼ in. Universal Motor for Mil spec. use; two 1½ in. Gearmotors giving 500 in. lbs. at 8 rpm; and VAX 4.5 Airborne Vaneaxial Blower.

Circle 272 on Inquiry Card

Meter Catalog

Empire Devices Inc., Amsterdam, New York, has available Catalog No. 614, covering their line of Noise and Field Intensity Meters, Impulse Generators, Power Density Meters, Modulation Meters, Crystal Mixers, and Microwave Components.

Circle 273 on Inquiry Card

Antenna Catalog

Catalog T, on "Telemetry Antennas and Accessories" is available from Andrew Corp., P. O. Box 807, Chicago 42, Ill. Photographs, charts, and spec. tables cover their 400-550 MC Quad Helix Antenna System, Broadband Omnidirectional Discone Antennas, Corner Reflector Antennas, and Helicone Feed Antennas.

Circle 274 on Inquiry Card

Photovoltaic Cells

Bulletin #03-301-A discusses the features, selection, and applications of an improved selenium photovoltaic cell developed by Weston Instruments Div., Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J.

Circle 275 on Inquiry Card

Chopper Circuits

Tech. report of test techniques and compiled data on residual noise present in chopper circuits is available from James Electronics Inc., 4050 N. Rockwell St., Chicago 18, Ill.

Circle 276 on Inquiry Card

Digital Voltmeter

Six-page Bulletin 311 describes Model 550 Digital Voltmeter. Illustrations of individual plug-in modules as well as internal views of the complete instrument are shown. Franklin Electronics, Inc., Bridgeport, Pa.

Circle 277 on Inquiry Card

Power Supply

Allen Electronic Corp., 937 Industrial Ave., Palo Alto, Calif., is offering tech. data on their Model 251 Power Supply. Unit has 4 separate, adjustable regulated and 1 unregulated outputs. Line and load regulation is 0.1%.

Circle 278 on Inquiry Card

Digital Voltmeter

Beckman/Berkeley Div., 2200 Wright Ave., Richmond, Calif., offers tech. data on their Model 4011 Digital Voltmeter, which features resolution of 0.01%. Information is also available on their Potentiometric Recorder, Model 93500, featuring multiple chart drive speeds and remote control.

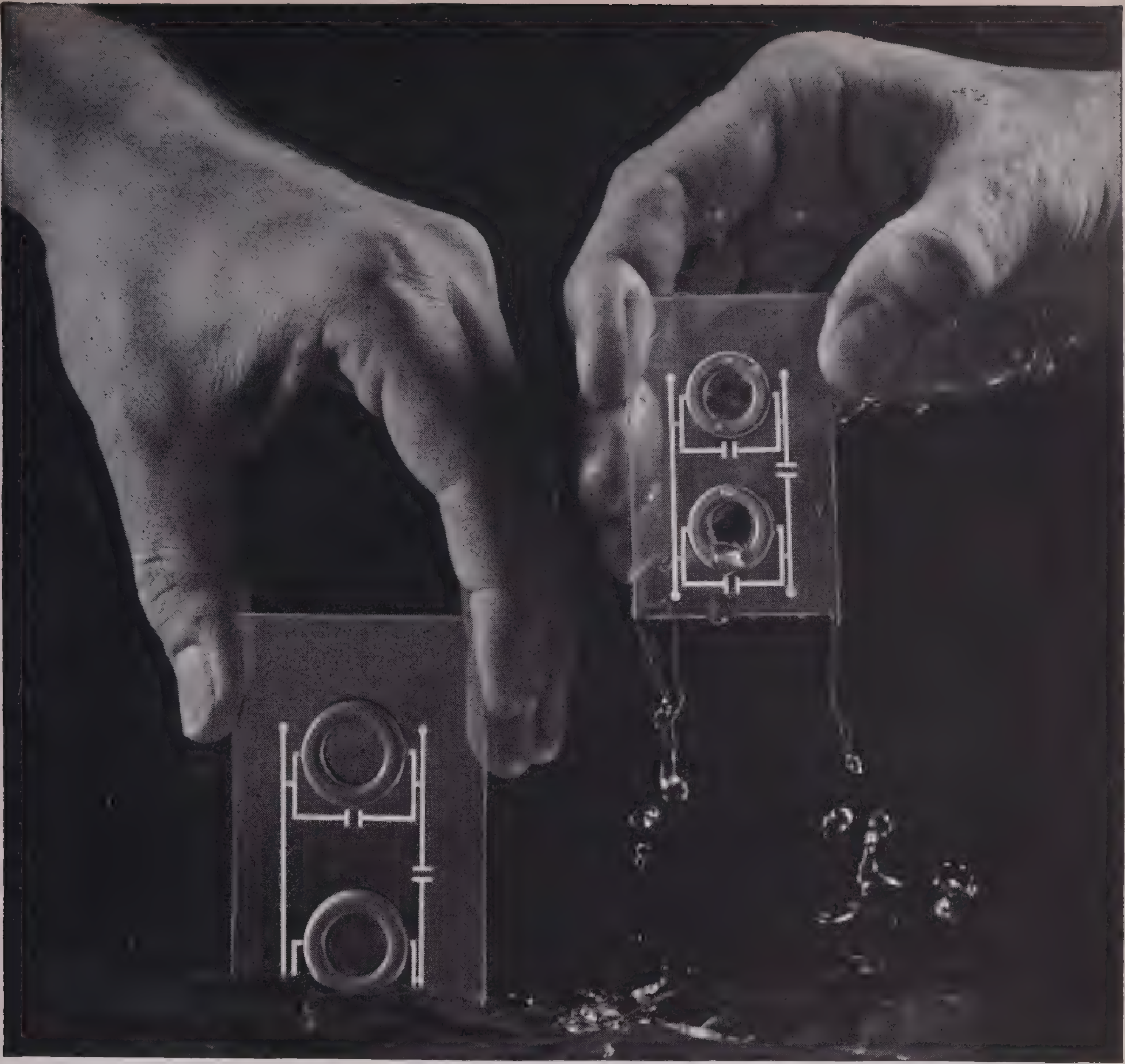
Circle 279 on Inquiry Card

Tungsten Alloys

Oregon Metallurgical Corp., P. O. Box 484, Albany, Ore., is offering tech. data on tungsten and tungsten alloys. The castings are manufactured by vaccum-arc melting and the pouring into a spinning mold of machined graphite. The resulting product is a sound, fine grained casting. Specification Tables are included.

Circle 280 on Inquiry Card

PUTTING MAGNETICS TO WORK



How to shrink a filter!

Magnetics Inc. "120" solves the problem of core size vs. inductance in miniaturized circuits

Trying to squeeze high core inductance into a small space for use in miniaturized resonance, filter, audio, or carrier frequency circuits usually ends in a compromise. You either force more out of a smaller core, or you use a larger one. Not so, however, if you're familiar with the Magnetics Inc. "120."

This molybdenum permalloy core has a .655 inch outer diameter—is just between the .500 and the .800 inch core you may be using. What makes this little fellow unique is its inductance per 1,000 turns . . . higher than either of its neighbors, whether 60, 125 or 160 permeabilities.

Note, too, that like all Magnetics Inc. powder cores, the "120" is performance-proved and rated within realistic inductance limits. All permeabilities are available from stock now. What's more, the 125 permeability core is inductance stabilized within ±0.1% from 0° to 55°C.

More information on this and other cores in the Magnetics Inc. line is contained in design bulletin PC-203 R. It's yours by writing *Magnetics Inc., Department EI-91, Butler, Pennsylvania.*

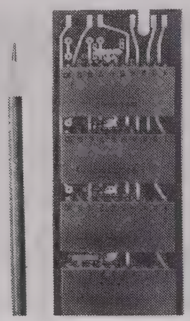
MAGNETICS inc. ®

See MAGNETICS Inc. BOOTH 1915 at WESCON

New Products . . . for the Electronic Industries

LOGIC MODULE

For use in control circuits, digital equipment and medical electronics.

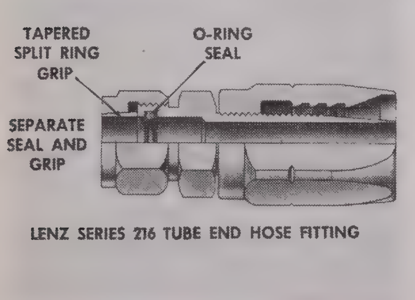


Each circuit block consists of 1 or 2 basic logic circuits performing specific functions, such as: flip-flop, pulse shaper, gate circuits, inverter amplifier, emitter followers, etc. The individual components comprising the circuit blocks are mounted on a printed wiring board, placed in a synthetic resin case, and capsulated to provide protection against shock, vibration and all other atmospheric effects. Amperex Electronic Corp., Icoma Div., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 281 on Inquiry Card

TUBE-TO-HOSE FITTING

Joins tube directly to a hose without adapter.



The Tube-End Hose Fitting uses Lenz O-Ring Seal® fitting with separate grip and seal. Eliminates need for a female swivel or any threading, flaring or soldering of tubes or pipes. The tube need not be cut straight or to exact length. Fittings available for either double wire braid hose (Series 216), or single wire braid hose (Series 116). The line ranges in hose size from 3/16 to 1½ in. I.D. with tube O.D. sizes from ¼ to 1½ in. The Lenz Co., 3301 Klepinger Rd., Dayton 1, Ohio.

Circle 282 on Inquiry Card

SILICON DIODES

Replaces Types 1N690, 1N691, 1N920 and 1N921.

Laminar® diode, type PS9013, has faster reverse recovery, and higher forward conductance characteristics than types it will replace. It has a capacitance of 7 pf at 9 v. reverse. Other characteristics are: Forward current at 0.9 v., greater than 500 ma; saturation voltage, greater than 80 v. at 25°C; reverse recovery less than 0.2 μsec. (switching 500 ma forward to −30 v. reverse recovery to 10K Ω). Pacific Semiconductors, Inc., 12955 Chadron Ave., Hawthorne, Calif.

Circle 283 on Inquiry Card

INDUCTANCE BRIDGE

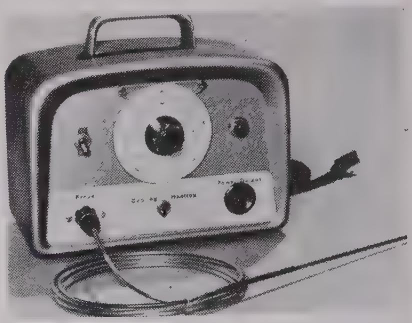
Designed for measurements in a-f ranges between 0.4 to 20 KC.

Basically a calibrated variable freq. osc. coupled to a mod. Maxwell bridge including a self-contained tunable null detector providing discrimination against unwanted distortion from components under test. Model 63B Inductance Bridge has direct reading calibration of both inductance and resistance dials; resolution to 0.01%. Specs include: inductance range, 0.02 μh to 11 h; resistance range 0.002 Ω to 110 k Ω; accuracy in the order of 0.25%. Boonton Electronics Corp., Morris Plains, N. J.

Circle 284 on Inquiry Card

TEMPERATURE CONTROLLER

Portable unit may be used in contaminated or corrosive atmospheres.



Temp-Trol® Model N-300 temp. controller, with a sensitivity range from −100°C to +300°C and accuracy to 0.5°C measures 8½ x 10 x 7 in. With heavy duty components it is actuated through a closed-loop servo control for reliability, and has a load of 15 a on both heating and cooling. Included with Temp-Trol N-300 is a fast response time probe. The unit sealed in a stainless steel housing. Omtronics Mfg., Inc., Box 1419 Peony Park Sta., Omaha 14, Nebr.

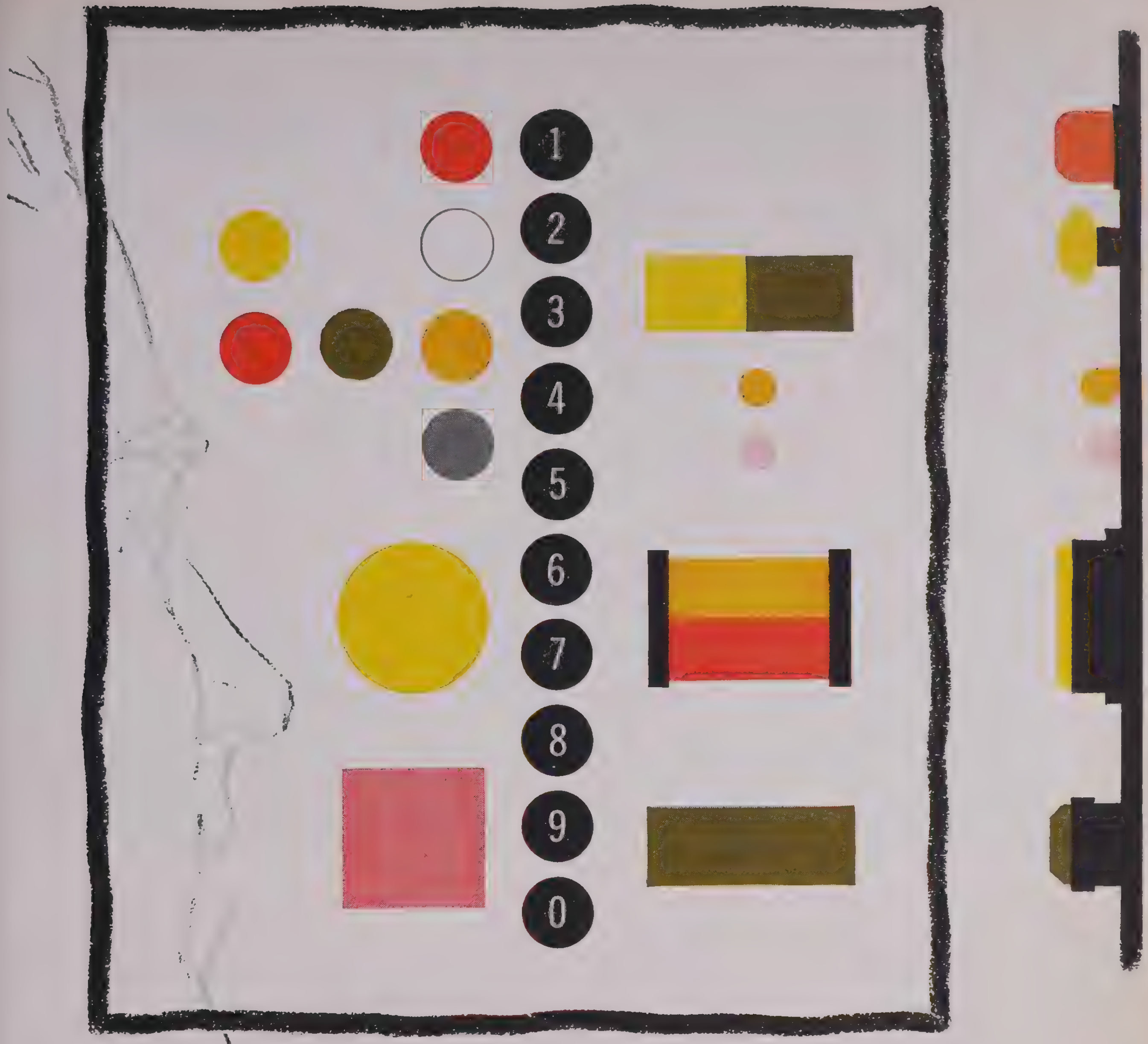
Circle 285 on Inquiry Card

QUAD AMPLIFIER

Model 620 is for applications requiring high accuracy and stability.

Compact half-rack unit combines 4 independent amplifier channels, power supply, input and output connections, gain control, over-load indicators and a panel meter for balancing and monitoring. Output is ± 100 v. full scale with up to 25 ma/channel (min. load of 4 K Ω). Stability approaches 0.1% at dc with internal networks. Drift (typical) less than 20 μv/24 hr. Operates from 110 v., 60 CPS ac. Beckman Instruments, Inc., Berkeley Div., 2200 Wright Ave., Richmond, Calif.

Circle 286 on Inquiry Card



IMPACT!

When a light comes on . . . or changes color . . . it immediately draws attention. Then add operator reaction . . . "hit that light when it turns red!". These are basic elements of today's sophisticated control panels.

Attention and reaction are built into all Control Switch lighted pushbutton switches. Round or rectangular buttons that light up in one, two, three or four colors, with monitor and control of up to four circuits.

For monitoring only, Control Switch indicator lights are available in hundreds of sizes, shapes, colors and circuits.

Write today for technical data on the industry's most versatile and complete line of lighted switches and indicator lights. If you have an unusual panel problem, let us solve it with a custom design.

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Manufacturers of a full line of switches, contr
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International

Electronic Sources

Up-to-the-minute abstracts of articles appearing in the leading foreign electronic engineering manuals

CIRCUITS

Ferrite Transducer for Electromechanical Filters, R. Lappa. "Prace ITE." Vol. 4, #3. 18 pp. Equivalent circuit of a ferrite transducer based on wave equation of vibrating rod and equations expressing the magnetostriction effect is discussed. The principle of electromechanical analogy between the phenomena of pressure waves propagation in a solid rod and the electromagnetic waves propagation in a transmission line is considered. (Poland.)

Design and Performance of a 450 Mc/s Parametric Amplifier, D. J. Mudgway. "Proc. AIRE." March 1961. 7 pp. The design and performance of a 450Mc/s parametric amplifier using the up-convertor configuration is described. (Australia.)

A Highly Sensitive DC Trigger, G. Thiele "El Rund." March 1961. 3 pp. The author briefly describes Schmitt's pulse-shaping circuit operating with electron tubes and then discusses a transistorized Schmitt trigger. (Germany.)

To Theory of Selective Rectification of Voltage Even Harmonics by Means of Symmetric Non-Linear Electrical Resistances, A. I. Kadochnikov, et al. "Avto. i Tel." April 1961. 8 pp. A circuit of selective rectification of voltage even harmonics designed on a symmetric non-linear electrical resistance is considered. Application of the circuit in an output net of a ferrosound (or magnetic amplifier of an even harmonic type) is also treated. (U.S.S.R.)

Ring Modulator with Integrated Filters, J. Salzmann. "Cab. & Trans." April 1961. 12 pp. The author proposes a new circuit without any transformer between rectifiers and filters, the assembly of which constitutes a lossless four-terminal frequency translating network, provided the impedances are well matched in the useful frequency bands. (France.)

A Pulse Generator with the Pulse Repetition Period Directly Proportional to the Control Voltage, L. Y. Ilnitzky, V. V. Tchervetzov. "Radiotek" 16, No. 2, 1961. 3 pp. This article deals with a fundamentally new circuit of a pulse generator whose pulse repetition period is directly proportional to the controlling voltage. (U.S.S.R.)

An Investigation of a Voltage Converter with an Impact Excitation Circuit, M. V. Agapoff. "Radiotek" 16, No. 4, 1961. 7 pp. The author analyzes existing methods of obtaining rectified voltages of large amplitude to feed electron-beam tubes and for other purposes. He shows that the efficiency of voltage converters which contain a circuit in impact excited operation, depends on the form of the entering signal. (U.S.S.R.)

Printed Circuit Techniques in the Design of Distributed Amplifiers, T. H. Shepertycki. "El. & Comm." April 1961. 4 pp. In the past many different types of lines have been used in the construction of distributed amplifiers. The amplifiers described use printed circuit techniques in their construction. Advantages of this type of construction are simplicity, reproducibility and the possible use of plug-line lines. (Canada.)

Frequency Modulation by Means of a Symmetrical Duodiode Circuit, B. Walter. "Prace ITR." Vol. 4, #4. 18 pp. The frequency of a LC oscillator may be modulated by means of a simple diode detector with variable resistance characteristics. The use of such a detector in a push-pull circuit gives much less frequency distortion and a lower level of spurious amplitude modulation in comparison to a single diode circuit. The paper deals with a theoretical analysis and design principles. (Poland.)

Cold-Cathode Tube Circuits for Automation, R. S. Sidorowicz. "Elec. Eng." March 1961. 6 pp. Cold-cathode tube circuit elements are described. The circuits are based on resistors, capacitors and three types of cold-cathode triode (types XC18, XC23 and XC24). (England.)

COMMUNICATIONS

Investigations on Infinite Amplitude Clipped Speech Properties for Application in Radiocommunication, S. Schmidt. "Prace ITR." Vol. 4, #4. 24 pp. One way of improving the speech-communication efficiency may be the infinite amplitude clipping of speech signal. The aim of this work was the experimental determination of the articulation properties (sound articulation) of Polish language in presence of random and non-random distortions. The investigations program was established from the point of view of speech transmission in radiocommunication channel with continuous modulation systems. (Poland.)

An Improved Design of Radio Relay Equipment in the 132-174 MC Range, A. Seljak. "El. & Comm." April 1961. 5 pp. Some important design principles encountered in the development of specific multi channel point-to-point communication equipment are discussed. (Canada.)

Communication Control and Intercommunication Systems for Aircraft, V. J. Chipperfield. "Brit. C. & E." May 1961. 6 pp. The need for communications services between a modern aircraft in flight and the ground has long been recognized and a considerable amount of complex radio apparatus is now carried by aircraft all over the world. (England.)

Interference Effects of Powerlines on Communications Systems, J. Sajonz. "Freq." March 1961. 9 pp. The paper explains the capacitive and inductive influences, studies the seriousness of the overvoltages generated by them and lists a variety of possible protective steps against excessive potentials and noise interference at the power end as well as at the communications end. (Germany.)

Trunk Line System of New South Wales, A. H. Little. "Proc. AIRE." Jan. 1961. 7 pp. A general historical review is given of the development of the N.S.W. trunk line system, and its rate of growth is discussed. (Australia.)

Luminous Mock-ups for Communication Systems, M. Jung. "Freq." April 1961. 5 pp. Luminous mimic diagrams serve for the central supervision (and control) of long-range communications networks and devices. (Germany.)

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
El Tech. Electronic Technology
GEC J. General Electrical Co. Journal
J. BIRE, Journal of the British Institution of Radio Engineers
Proc. BIEE, Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Bull. Fr. El Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
El. et Auto. Electronique et Automatisme
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
Nach. Z. Nachrichtentechnische Zeitschrift
Rt. Regelungstechnik
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechnizne

USSR

Avto. i Tel. Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radioteknika i Elektranika
Rad. i Elek. Radioteknika i Elecktranika
Iz. Acad. Bulletin of Academy of Sciences USSR.

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Philadelphia 39, Pa.

Recent USAF release makes

MOTOROLA MINUTEMAN MESA TRANSISTORS

available for your military application

For the first time, Motorola Mesa transistors tested to the rugged requirements of the Minuteman high-reliability program (conducted by Autonetics Division, North American Aviation, Inc.) are available for *all* military applications. Every process and quality control procedure that made these units *the most reliable transistors* in this high-priority program can now help you achieve greater reliability in your military circuitry.

The Minuteman units immediately available from Motorola include:

101A, 101B and 101M – PNP germanium high-frequency switching transistors for high-speed computer and data processing applications.

201A, 201B and 201M – PNP germanium amplifier transistors for use in communications equipment, radar IF strips, fixed IF strips, wide-band amplifiers and precision oscillators.

These Motorola units have successfully demonstrated a failure rate of less than .003%/1000 hours under accelerated stress conditions to the three-year end points of the program*. They are now in the final test phase to assure a .0007%/1000 failure rate level . . . the most stringent requirement of any transistor in the missile's guidance system. The same life-test data required with Minuteman devices is also available to you.

FOR COMPLETE TECHNICAL INFORMATION ON MOTOROLA MINUTEMAN MESAS OR INDUSTRIAL-TYPE MESAS call your Motorola Semiconductor district office or write Motorola Semiconductor Products Inc., Dept. 101, 5005 East McDowell, Phoenix 8, Arizona.

*At a 60% confidence level with an assumed acceleration factor of 32.

MOTOROLA MINUTEMAN MESA TRANSISTORS

Characteristic	Symbol	Type No. 101A, B&M	Type No. 201A, B&M	Unit
Collector-Base Voltage	BV_{CBO}	15	15	Volts
Emitter-Base Voltage	BV_{EBO}	5	2	Volts
Collector Current	I_C	100	100	mA
DC Base Current (Max. @ $I_C = 50$ mA)	—	1.25	—	mA
Current Transfer Ratio (Min. @ f = 1 kc & $I_C = 1.5$ mA)	h_{fe}	—	45	—

$T_j = -65$ to $+100$°C P_D (25°C Case Temp.) = 300 mW

NOTE: "A" units supplied to Measurement Acceptance Tests group A & B.
"B" units supplied and certified to complete Minuteman specifications.
"M" units certified to complete Minuteman specifications and supplied board mounted and serialized with computer card data.

INDUSTRIAL MESAS ALSO PRODUCED WITH MINUTEMAN PRODUCTION CONTROL TECHNIQUES

The same processes and quality control procedures used for Minuteman units are also applied to other Motorola Mesas. These germanium units incorporate the inherent reliability of the Minuteman process and are available in production quantities to industrial equipment manufacturers.

MOTOROLA
Semiconductor Products Inc.
A SUBSIDIARY OF MOTOROLA INC.
5005 EAST McDOWELL ROAD • PHOENIX 8, ARIZONA

LOOK TO MOTOROLA FOR ALL YOUR SEMICONDUCTOR REQUIREMENTS
POWER TRANSISTORS • MESA SWITCHING & AMPLIFIER TRANSISTORS • MILLIWATT TRANSISTORS • SILICON RECTIFIERS • ZENER DIODES

Circle 73 on Inquiry Card

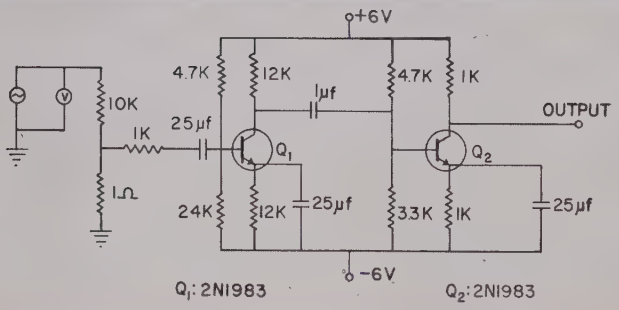
DOUBLE-DIFFUSED SILICON INDUSTRIAL TRANSISTORS

HIGH GAIN LOW COST

FAIRCHILD 2N1983

- produces circuit voltage gains of 1,000 and up
- price is competitive with germanium and lower performance silicon
- eliminates hum and microphonics in low noise circuit design
- provides low noise circuit performance from 1KC to 150KC
- permits circuits with very low power consumption
- operates over a wide temperature range, up to 125°C.

For fast deliveries, call your Fairchild Distributor or factory field sales office. Write for complete specifications and pricing information on the total Fairchild line... Industrial Silicon Transistors and Diodes; Silicon Planar Transistors and Diodes, and Special Products.



CIRCUIT TEST RESULTS OF RANDOM 2N1983 SAMPLES FOR Q_1

Q. 1	Noise Referred To Input In µ Volts	Voltage Gain
#1	13	1000
#2	20	1080
#3	20	1080
#4	21	1080
#5	18	1080
#6	20	1190
#7	16.8	1190
#8	18.4	1190
#9	17	1190
#10	19	1190

10 SAMPLES TESTED

MAXIMUM RATINGS at 25° C

V_{CBO} — Collector to Base Voltage	50 Volts	V_{EBO} — Emitter to Base Voltage	5.0 Volts
V_{CEO} — Collector to Emitter Voltage	25 Volts	P_D — .6 Watts in Free Air	

ELECTRICAL CHARACTERISTICS (25° C unless otherwise noted)

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
V_{BE}	Non-Saturated Base Voltage		.85	Volts	$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
R_{CS}	Saturation Resistance		50	ohms	$I_C = 5.0$ mA	$I_B = 0.5$ mA
h_{fe}	High Frequency Current Gain f = 20 mc	2.0			$I_C = 50$ mA	$V_{CE} = 10$ V
C_{ob}	Output Capacitance		45	pf	$I_E = 0$	$V_{CB} = 10$ V
I_{CBO}	Collector Cutoff Current		5.0	µA	$I_E = 0$	$V_{CB} = 30$ V
I_{CBO} (+150° C)	Collector Cutoff Current		200	µA	$I_E = 0$	$V_{CB} = 30$ V
V_{CER} (sust)	Collector to Emitter Sustaining Voltage (Pulsed)*	30		Volts	$I_C = 100$ mA	$R_{BE} \leq 10\ \Omega$
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Pulsed)*	25		Volts	$I_C = 100$ mA	$I_B = 0$
I_{EBO}	Emitter Current		100	µA	$I_C = 0$	$V_{EB} = 2.0$ V

*Rating refers to a high current point where collector-to-emitter voltage is lowest.
For more information send for Fairchild Publication APP 4

SMALL SIGNAL CHARACTERISTICS (f = 1 kc) 2N1983

Symbol	Characteristic	Min.	Max.	Units	Test Conditions	
h_{fe}	Current Gain	70	210		$I_C = 1.0$ mA	$V_{CE} = 5.0$ V
		80	240		$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
h_{ib}	Input Resistance	20	30	ohms	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
		4.0	8.0	ohms	$I_C = 5.0$ mA	$V_{CB} = 5.0$ V
h_{rb}	Voltage Feedback Ratio		7.0	$\times 10^{-4}$	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
			7.0	$\times 10^{-4}$	$I_C = 5.0$ mA	$V_{CB} = 5.0$ V
h_{ob}	Output Conductance		1.0	µ mho	$I_C = 1.0$ mA	$V_{CB} = 5.0$ V
			1.5	µ mho	$I_C = 5.0$ mA	$V_{CB} = 5.0$ V
h_{ie}	Input Resistance		2000	ohms	$I_C = 5.0$ mA	$V_{CE} = 5.0$ V
h_{oe}	Output Conductance		200	µ mho	$I_C = 5.0$ mA	$V_{CE} = 5.0$ V

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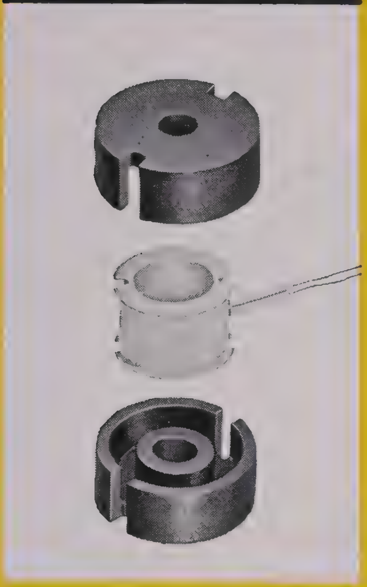
Probing new dimensions in Electronics through Stackpole Research . . .



A MAJOR NEW FERRITE

FOR TELE-COMMUNICATIONS

Permeability: 1800

Temperature Constant: 1.8×10^{-6} per °C (—20° to 120° C)

Avg. Temperature Coefficient (un-gapped cores): 0.29% per °C (—20° to 85°C)

μQ (merit factor): Greater than 200,000 at 100 kc

. . . these in brief are the salient electrical characteristics of Stackpole *Ceramag 501*—a remarkable new low-loss ferrite grade for the 10 kc to 250 kc range. Already revolutionizing the design of carrier-current communications filters, the material shows considerable promise for electronic switching circuits and others as well.

Cup cores of Ceramag 501 no larger than a quarter enable the design of filters with such narrow pass bands that message-handling capacities of communications systems can be increased from 2 to over 90 messages per channel. The extraordinary high gain of filters using Ceramag 501 combine with other inherent advantages—smaller size, no aging or life problems—for a significant contribution to system reliability.

But equally significant is the extremely close tolerances to which these cores are made. To achieve the exact air gap required, Ceramag 501 cups are supplied in matched pairs. Special Stackpole-designed mounting hardware and tuning slugs can also be supplied to assure easy assembly and maximum electrical performance with your own coil designs.

Almost four years in development, Ceramag 501 represents another basic contribution based on magnetic ceramic research and engineering by the oldest commercial ferrite producer in the United States.

Complete details on Ceramag 501 and the remarkable research facilities that made it possible are available upon request to the *Electronic Components Division,* Stackpole Carbon Company, St. Marys, Pa.

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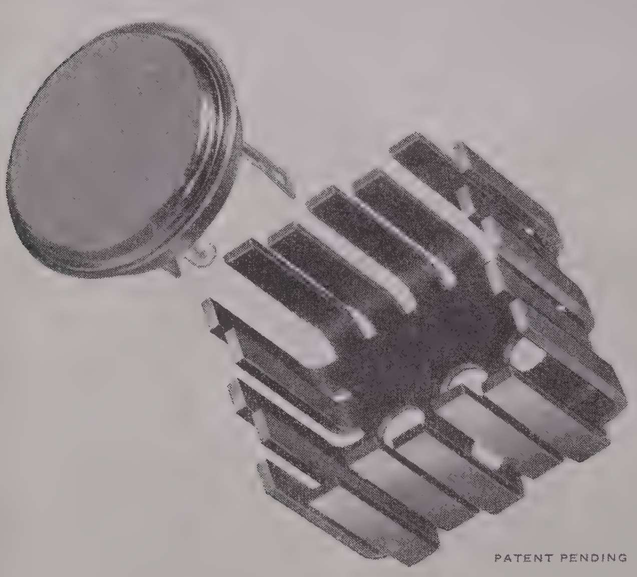

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Sources

Functions of an Ideal Receiver. N. L. Teplov. "Radiotek" 16, No. 3, 1961. 9 pp. Functions of an ideal receiver are determined, depending on the statistical communication structure and the signal form. (U.S.S.R.)

Potential Immunity to Noise for the Spaced Reception of Discrete Information. D. D. Klovsky. "Radiotek" 16, No. 3, 1961. 9 pp. Criteria are obtained for optimal coherent and incoherent reception in the presence of: fluctuating noise, Raleigh's amplitude distribution of signals received in separate diversion branches and in the absence of correlation between them. Potential immunity to noise is determined for a broad class of communication systems with an active pause and orthogonal in the applied sense. (U.S.S.R.)

GENERAL

A Simple Analog Multiplier, A. Schief. "El. Rund." April 1961. 2 pp. There are several methods to multiply quantities varying in time. Generally, they call for substantial component expenses. The analog multiplier described here comprises a modulator equipped with switching diodes and is operated with an auxiliary alternating voltage. (Germany.)

Noise-Proof Features of a Type WOY Receiver in the Presence of Fluctuation Noise, I. M. Teplyakoff. "Radiotek" 16, No. 4, 1961. 3 pp. For various relationships of filter passbands with wide and narrow bands, probability curves are constructed for the case of ideal limitation, which give the probability of a signal pulse not being transmitted. A comparison is made with an ideal receiver. (U.S.S.R.)

One Method of Frequency Multiplication, M. S. Araloff. "Radiotek" 16, No. 4, 1961. 2 pp. A method is analyzed to multiply frequencies with the aid of a characteristic. It is shown that under these conditions, the second harmonic component reaches a value of 0.5 Iam, whereas, odd components are suppressed. (U.S.S.R.)

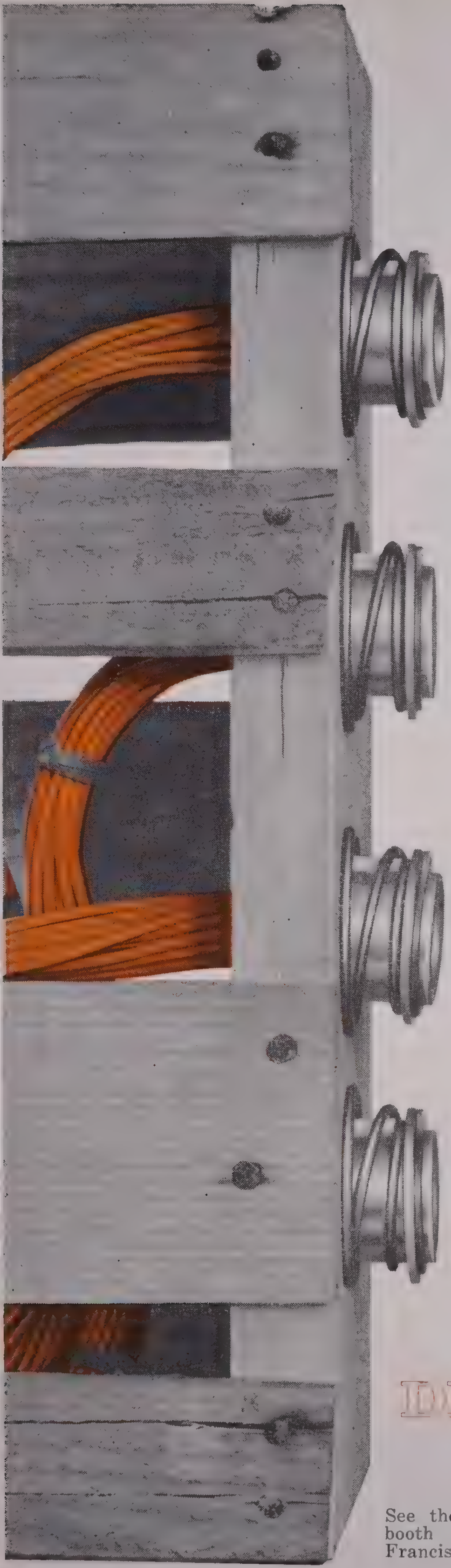
Use of Heterogeneous Lines to Match Complex Impedances in the Super-High Frequency Band, S. I. Orlov. "Radiotek" 16, No. 2, 1961. 9 pp. A method is presented for the design of a transformer in the form of a section of a heterogeneous line to match an arbitrary complex impedance, whose coefficient of reflection is $\Gamma \leq 0.4$, with the impedance of a coaxial line at a number of discrete frequencies in the matched band. (U.S.S.R.)

Noise Limiter with a Threshold Follower, A. A. Gorbatcheff. "Radiotek" 16, No. 2, 1961. 11 pp. A bilateral clipper of noise pulses is studied whose limiting threshold follows the level of the signal. This clipper is inserted into the low-frequency section of a receiver device. Results of experimental tests are given. (U.S.S.R.)

Scintillation Counters and Phosphors, D. R. Trotman. "Brit. C.&S." May 1961. 6 pp. This article deals with the theory and operation of a scintillation counter. Various radiations are considered, in conjunction with the theory of phosphors. (England.)

Bootstrap Sawtooth Generators with Enhanced Voltage Linearity, K. Thiele. "El. Rund." April 1961. 4 pp. The linearity of a bootstrap-generator sawtooth output can be substantially improved when an integrating compensation network is built in. In this first part of the paper, the voltage rise of a bootstrap sawtooth generator so compensated is computed. (Germany.)

(Continued on page 146)



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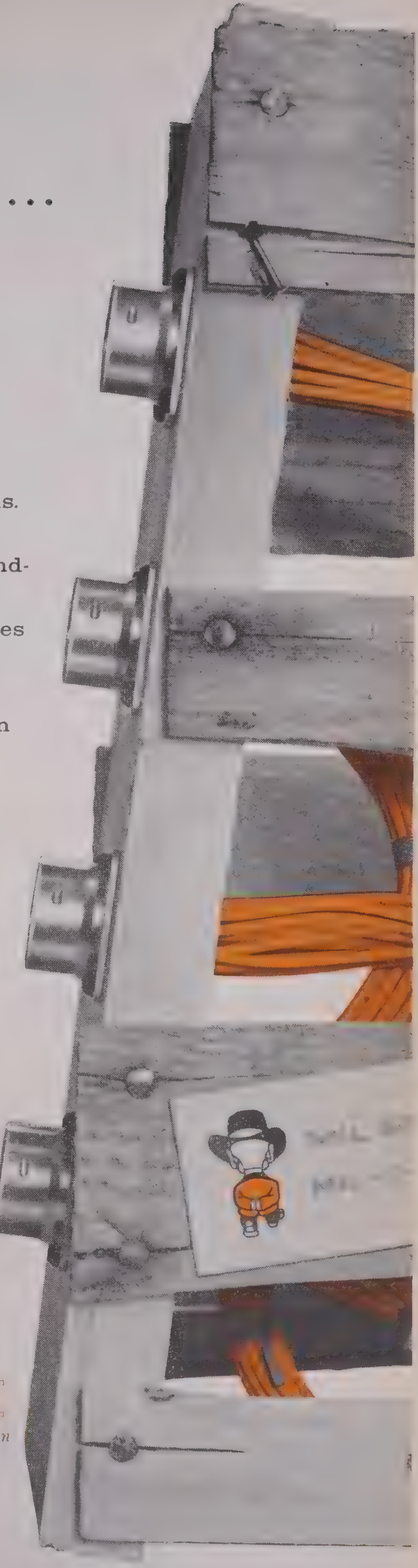

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Co-Netic and Netic alloys are not affected significantly by dropping, vibration or shock. They are characterized by low magnetic retention and do not require periodic annealing. When grounded, they effectively shield electrostatic as well as magnetic fields over a wide range of intensities.

Every satellite and virtually all guidance devices increase reliability with Netic and Co-Netic magnetic shielding alloys. Use these highly adaptable foils for saving valuable space, weight, time and money . . . in solving your magnetic shielding problems for military, commercial and laboratory applications.

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Sources

An Approximate Calculation of Coefficients of Depression for Tubular Electron Beams, L. N. Loshakoff. "Radiotek" 16, No. 2, 1961. 4 pp. Results are presented of calculations of the coefficient of field depression for a volumetric charge for certain lower types of waves of a free electron beam with a ring-shaped cross-section. (U.S.S.R.)

An Improved Voltage Stabilizer, A. K. Chatterjee, et al. "Elec. Eng." May 1961. 4 pp. In an amplified degenerative type of voltage stabilizer, two stages of dc amplification are often used in the shunt control circuit to improve stabilization with respect to output voltage fluctuations. Input compensation introduced in the suppressor grid of the second dc amplifier valve results in very high stabilization with respect to input voltage fluctuations. (England.)

A Pseudo-Linear Method Applied to the Design of Harmonic Frequency Multipliers and Dividers, I. T. Turbovich. "Radiotek" 16, No. 4, 1961. 9 pp. It is shown that the equivalent circuit of proportional frequency multipliers and dividers can be represented in a form of two consecutively connected four-pole networks: A non-inertial, non-linear network and an inertial linear one. (U.S.S.R.)

Influence of Flaws on the Field Distribution in the Railway Bar and Directions for Magnetical Flaw Detection, A. Spichalski. "Roz. Elek." Vol. 7, #1. 41 pp. Properties of magnetic defectoscopy compared with detection by current method. (Poland.)

Thermoelectricity Permits New Design Concepts in Cooling Equipment, James Keane. "Can. Elec. Eng." May 1961. 3 pp. A laboratory cooler has been developed which uses standard thermoelectric modules and can provide temperatures down to —20°C. (Canada.)

Filter Design Using Catalogs of Low-Pass Filters, R. Saal. "Freq." April 1961. 11 pp. Unlike filter design by the earlier image parameter theory, the design of filters by the insertion-loss theory, according to general opinion, is the domain of specialists because of the complex calculation work involved. (Germany.)

An Improved Range of VHF and UHF Radio Equipment, H. Dolan. "ATE J." Oct. 1960. 12 pp. The type 800 range of vhf and uhf equipment embodies design improvements over the earlier Type RL range. After describing the various units—transmitters, receivers, etc., particulars of the mechanical design are given. The article concludes with reference to the test equipment, propagation and applications. (England.)

About New Stability Inequalities, I. S. Arzhanykh. "Avto. i Tel." April 1961. 7 pp. New inequalities are given which are based on Shoura theorems and which are used in analysis of stability of systems described by differential equations with constant or periodic coefficients. (U.S.S.R.)

The Second Road to Education, R. Schulter. "Freq." April 1961. 2 pp. The big chance for the talented coming generation among workers—course of education on a par with others—recruiting the hidden talent. (Germany.)

The Magnetic Drum in Relation to Subscriber Trunk Dialling, W. A. C. Hemmings. "ATE J." Oct. 1960. 19 pp. The article covers the magnetic drum register-translator for handling trunk traffic from director areas under the system of subscriber trunk dialling. (England.)

Determination of Optimum with White Noise Transfer Function of Servosystem According to its Quality Factor and Duration of Transient Process, A. S. Kulchy. "Avto. i Tel." April 1961. 6 pp. A connection between coefficients of a systematic error and duration time of transient process with securing the least value of mean-square error is found. (U.S.S.R.)

(Continued on page 157)

Transitron

ANNOUNCES
NEW DEVELOPMENTS
IN ITS
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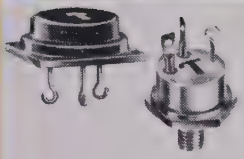
SILICON POWER TRANSISTORS

IN THE HIGH POWER RANGE, THE TRANSITRON UNITS FEATURE:



- the widely accepted stud-mounted package, pioneered by Transitron
- low saturation resistances
- voltages to 100 volts
- reliability-tested specifications

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Type	Maximum Power Dissipation at 100°C Case (Watts)	Maximum Collector Voltage V_{CB} (Volts)	Minimum DC Common Emitter Current Gain at 2 Amps β	Typical Collector Saturation Resistance (Ohms at 2 Amps)
2N1616	30	60	15	0.7
2N1617	30	80	15	0.7
2N1618	30	100	15	0.7
2N1210	30	60	15	0.7
2N1211	30	80	15	0.7
2N1620	30	100	15	0.7

IN THE INTERMEDIATE POWER RANGE, THE NEW TRANSITRON UNITS FEATURE:

- 7/16" hex base stud-mounted package
- saturation resistances under 3 ohms (2N1647-50 series)
- guaranteed Betas over normal operating range
- voltage ratings as high as 200 volts (2N2018-21 series)
- true intermediate power capability

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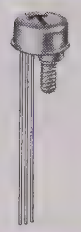
Type	Maximum Collector Voltage BV_{CEX} (Volts)	Maximum Power Dissipation at 100°C Case (Watts)	Minimum DC Common Emitter Current Gain at 500 mA β	Minimum Collector Breakdown Voltage at 50 mA BV_{CEO} (Volts)	Typical Saturation Resistance (Ohms)
2N2018	150	20	20	125	3.5
2N2019	200	20	20	140	3.5
2N2020	150	20	40	125	3.5
2N2021	200	20	40	140	3.5
2N1647	80	20	15	60	1.9
2N1648	120	20	15	80	1.9
2N1649	80	20	30	60	1.9
2N1650	120	20	30	80	1.9

The widest range of silicon power transistors is now available as the result of Transitron's development of an advanced line of competitively priced silicon transistors in the intermediate and high power ranges.

Electrical and mechanical advantages of the Transitron devices include low saturation resistances, voltages up to 200 volts, and solutions to heat dissipation problems that have long plagued designers. Included in this broad line are a number of silicon power transistors that Transitron is marketing at prices geared to the budget of the *industrial* designer!



ALSO AVAILABLE 2N1047-50 and 2N1047A-50A SERIES OF **INTERMEDIATE POWER SILICON TRANSISTORS . . .** for applications which require the single-ended, stud package.

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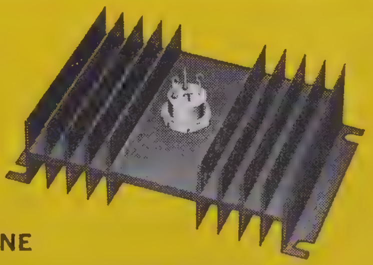

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NEW
STANDARD LINE OF NATURAL CONVECTION COOLERS

Transitron has recently canvassed the market for the best available natural convection coolers. Under laboratory conditions, research engineers conducted a series of unbiased tests to determine which coolers possess the best heat dissipation capabilities for Transitron power semiconductors.

As a result, Transitron now offers a new standard line of four natural convection coolers, backed by extensive applications know-how. Transitron is thereby the first company to offer its customers a systematic and continuing program of service for the solution of annoying heat dissipation problems.

For further information, write for Application Notes AN-1355C and Bulletin TE-1355-1.

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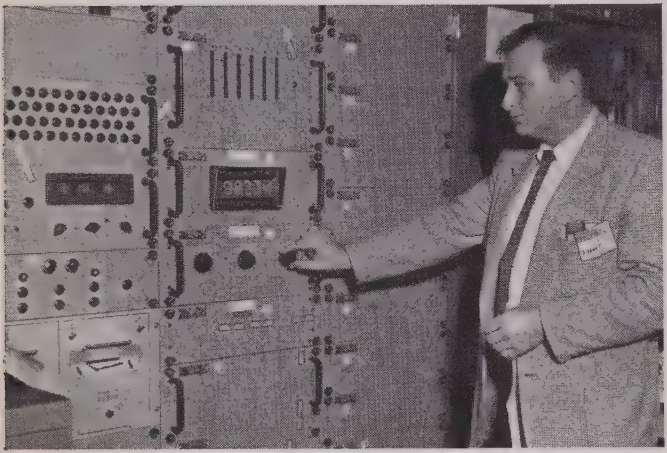
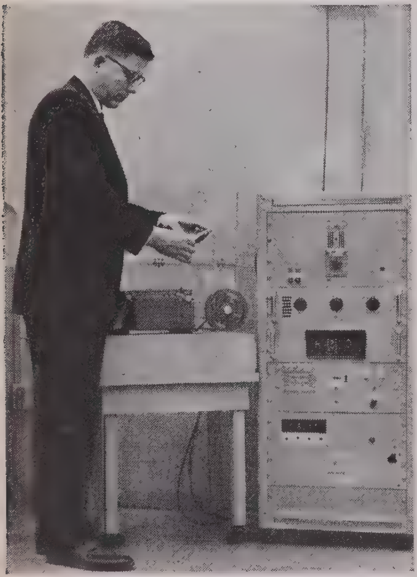
FINAL PRODUCTION TESTING. Zener diodes are checked by NLS M24s at final testing stations of Hughes Aircraft Company's Semiconductor Division.

CHECKOUT OF MISSILE COMPONENTS. An M24 checks electronic components at Autonetics, a division of North American Aviation, Inc., as part of the High Reliability Program for Minuteman ICBM. The operator is shown measuring resistance. By turning a front panel knob on the M24, she can also measure DC voltage or DC voltage ratio.



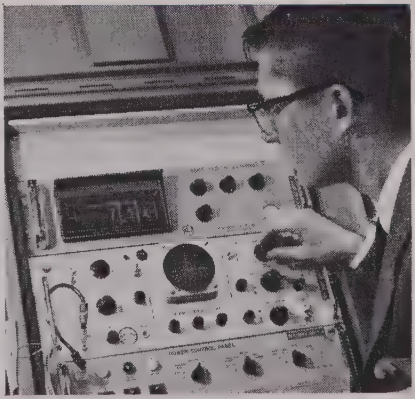
MISSILE PRODUCTION TESTING. An NLS M24 Multi-Purpose Instrument performs an important part in the missile functional test system at Boeing Airplane Company's Missile Production Center in Seattle, Wash. The system automatically applies more than 400 go/no-go sequenced tests to ground-check missile flight reactions from launch to intercept. The M24 and the printout portion of the system monitor application of test stimuli and isolate malfunctions.

ELECTRO-CHEMICAL ANALYSIS. Savings of as much as $8,000 a year on one particular project are expected to result from use of an NLS 481 DVM at Diamond Alkali Company's plant in Deer Park, Texas. By accurately measuring small changes in voltage and voltage drop, it permits optimizing the efficiency of producing chlorine from sodium chloride brines by electrolysis.

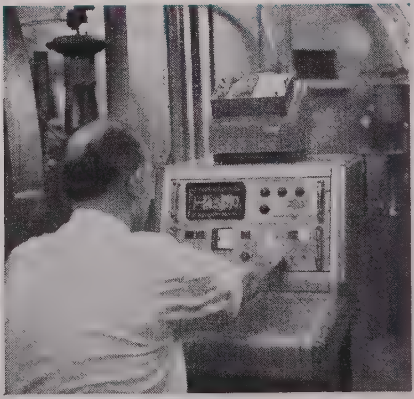


PETROLEUM RESEARCH AND DEVELOPMENT. This precision data logging system, incorporating an NLS V24 DVM, has served Esso Research Laboratories for more than two years in around-the-clock service. The V24 converts millivolt signals to digital form for operating a Friden Tape Punch. The system aids in making pilot plant studies of industrial processes.

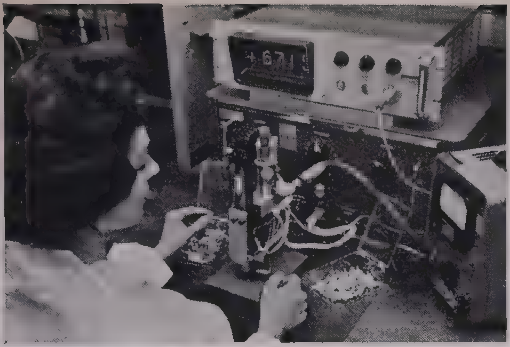
ACCEPTANCE...



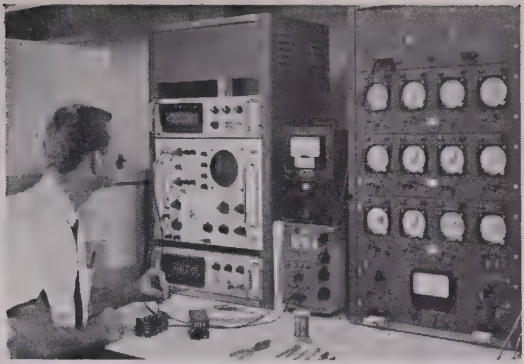
MISSILE TRACKING SYSTEMS. The Azusa Test Set, designed by General Dynamics/Astronautics, A Division of General Dynamics Corporation, includes an NLS V35 DVM. This set checks the power and transmitter portions of the airborne package of the system which is used for tracking all missiles launched from Cape Canaveral. Functions of the V35 include monitoring of 28-, 100- and 1,500-volt power supplies; calibrating telemeter transducers; and adjusting Klystron beam, bias and modulator voltages.



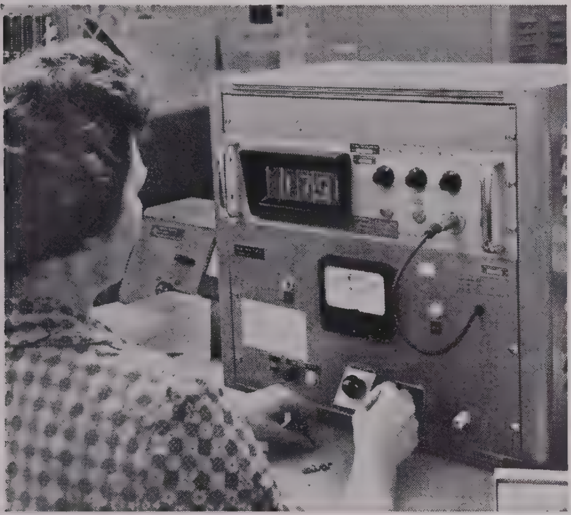
SPACE MEDICINE RESEARCH. In simulated space environment testing, this NLS V34 digital voltmeter is part of a system which detects and records minute changes in body weight, a key factor in determining physiological strain. The unique "No Needless Nines" logic of the V34 permits measurements at pre-selected time intervals with an accuracy of ±3 grams within a range of ±4,500 grams. AMF's Mechanics Research Division developed the overall system under direction of the Air Force's Aeronautic Systems Division at Wright-Patterson AFB in Ohio.



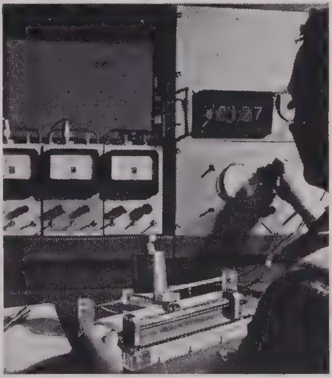
PRODUCTION TESTING. A 481—one of a battery of NLS DVMs—measures Zener diodes for separation into voltage categories at the Semiconductor Products Division of Motorola, Inc. Measuring speed for this operation was doubled by use of the NLS digital voltmeters.



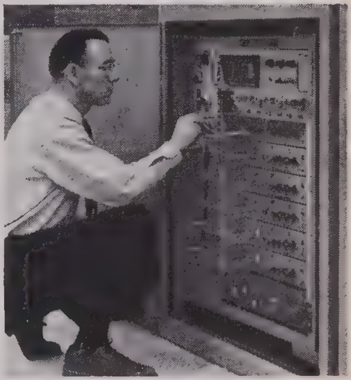
MISSILE CHECKOUT. Two NLS DVMs team up on checkout of equipment for the GAM-77 Hound Dog Missile at the West Coast Laboratories of Mallory Electronics Company, A Division of P. R. Mallory & Co. Inc. The 481 (bottom) calibrates remotely settable timers for the Hound Dog and the V35 (top) is used for final checkout of these devices. "By using DVMs, we are able to eliminate human error in final inspection," said a Mallory executive.



QUALITY CONTROL OF ELECTRONIC COMPONENTS. More than 50 NLS 481 digital voltmeters are used in the Quality Assurance Program at the Semiconductor-Components Division of Texas Instruments Incorporated. The instrument pictured is measuring breakdown voltages of high-reliability germanium switching devices.



MATERIALS EVALUATION. Electronic Chemicals Division of Merck & Co., Inc., uses a 481 DVM to reduce testing time for determining resistivity of single crystal silicon.



A-TO-D CONVERSION IN INDUSTRIAL PROCESSING. A 481 DVM operates an analog-to-digital converter in a variance computer for Saran Wrap production at The Dow Chemical Company's Saran Wrap plant in Midland, Mich.

sign of superiority in digital voltmeters

If you measure or record voltage, consider the broadening applications of digital voltmeters as indicated by these examples. The NLS instruments shown here . . . and the thousands of others in action today . . . tell a story of acceptance that is three-fold:

1. The digital voltmeter—first unique instrument since the development of the oscilloscope and vacuum tube voltmeter—has become a *basic measuring and logging tool* since its origination by Non-Linear Systems, Inc., nine years ago.

2. NLS digital voltmeters have been *proved in use* by many of the most discriminating companies in the electronics and allied industries.

3. Most of these firms have *specified NLS again and again,* some owning more than fifty instruments . . . evidence of the acceptance of NLS, as well as the usefulness of the product it manufactures.

Our point: it makes sense to contact the most experienced manufacturer of digital voltmeters to meet your measuring and data logging needs. Select from the world's most complete line . . . by purpose . . . by price. NLS offers 16 basic models—all with exclusive features—from a low-cost "Industrial" type instrument to a $6,150 all-electronic DVM that makes 200 readings per second. For the most complete and authoritative information available on DVMs, contact your local NLS office or rep, or write NLS.

NLS **non-linear systems, inc.** *Originator of the Digital Voltmeter*
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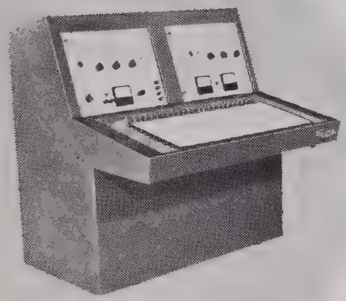

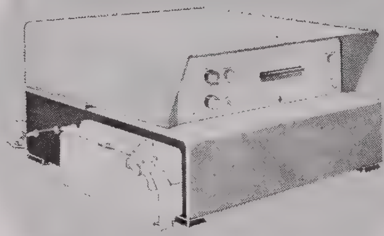

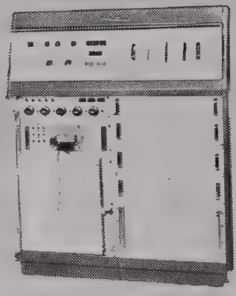

MODEL 20
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Automatic Circuit Analyzer

AC dielectric tests

DC continuity and short tests

Test voltages:
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500 or 1000V DC
28V DC

Dwell time, 10 seconds to 3½ minutes.

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Cards marked by the programmer are inserted into the tapewriter. Pressing a switch causes the program information to be automatically punched into the tape. The tapewriter will operate as either a line or block tape punch. From one to 12 lines can be punched simultaneously.

MODEL 720
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Voltage measurements, 0.001-39.9V

Resistance measurements, 0.01 ohms-9.99 megohms

Current measurements 0.1 microamps-500 milliamps

Dwell time, 0.1-10 seconds

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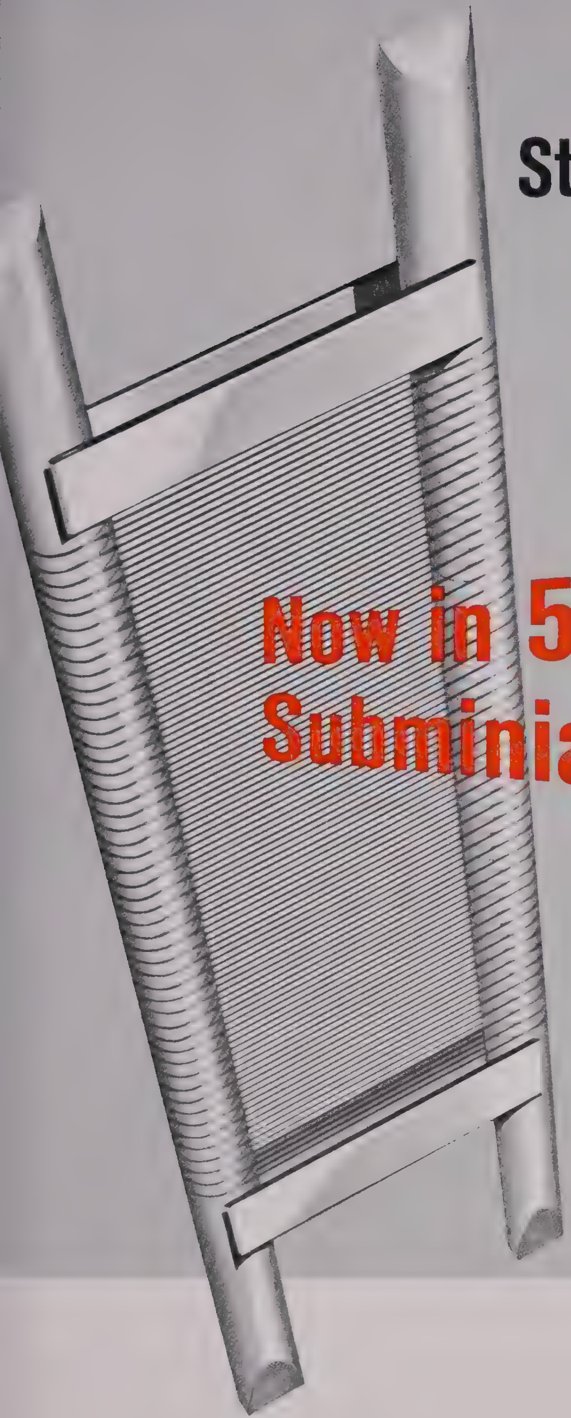
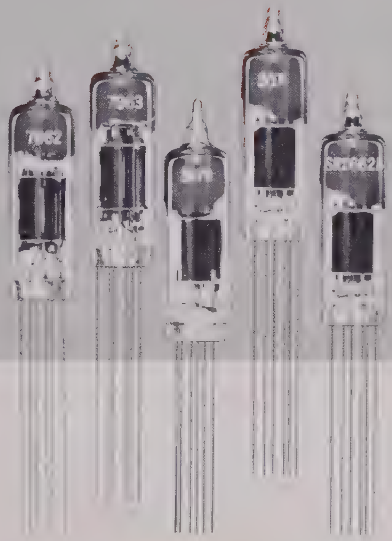
ELECTRON TUBE NEWS from SYLVANIA

Strap Frame Grid Performance & Gold Brand Reliability



Now in 5 New Sylvania Subminiature Tubes!



If you've been seeking tubes with an optimum combination of high performance, resistance to environmental stresses, genuine interchangeability, small size/weight, assured reliability . . . let Sylvania shorten your search.

Few devices can fill those requirements so impressively as these five new Gold Brand Subminiature Tubes featuring Strap Frame Grids . . . Sylvania-7962, 7963, 8070, 8071, SR-2662A. Here's why—

HIGH PERFORMANCE—Sylvania Strap Frame Grid design significantly improves tube characteristics for Gm, Gm:Ib, gain, bandwidth, and noise. (Fig. 1)

ELECTRICAL STABILITY—rugged Strap Frame Grids retain precise physical dimensions and, therefore, electrical stability, over an exceedingly long, useful life. Specially designed heaters tolerate wide voltage variations of ±10% of specified ratings. Too, Gold Brand Subminiature types exhibit an inherent resiliency to plate and screen voltage surges.

DURABILITY

Shock—Sylvania Gold Brand Subminiature Tubes are designed to withstand impact acceleration tests of 500g and fatigue tests of 2.5g for periods of 96 hours.

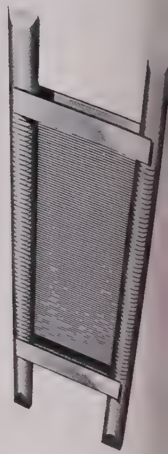
Radiation—they demonstrate remarkable resistance to radiation effects, tolerate dose rates of 10^{12}nv, total dosage of 10^{16}nvt.

Temperature—not susceptible to thermal runaway, they perform at ambient bulb temperatures of as high as 220°C, withstand prolonged storage temperatures.

INTERCHANGEABILITY—exceptionally low dispersion of characteristics (electrical uniformity) from tube to tube within a given type offers genuine interchangeability without costly preselection and testing.

RELIABILITY—several authoritative, documented examples of reliability under field and laboratory conditions are cited on the following page.

NEW DESIGN SYLVANIA SUBMINIATURE TUBES FEATURE STRAP FRAME GRIDS



Sylvania-7963, medium-mu double triode . . .

For use as an RF or pre-IF amplifier in missiles, radar, radiosonde and beacon receivers, telemetering equipment or as a blocking tube oscillator. It's a high-performance version of the general-purpose 6021 with higher heater power and huskier cathode. Per section: Gm is 13,000 μmhos, Gm:Ib is 1,730.

Sylvania-7962, medium-mu double triode . . .

Featuring very low heater power of 0.7W per section, low Eb of 30V per section. It's designed for application as an RF or pre-IF amplifier or multivibrator in conjunction with low B+ supplies. Per section: Gm is 9,500 μmhos (80% higher than conventional prototypes), Gm:Ib is 1,055.

Sylvania-8070, high-mu triode . . .

Draws only 125mA @ 6.3V heater power. It's used as an RF amplifier in communication equipment, pre-IF amplifier in navigational radar and beacon receivers, telemetering receivers. Gm is 11,000 μmhos, Gm:Ib is 1,222. 8070 provides 2.5 db better gain than usually encountered in present high-performance types

Sylvania-8071, high-mu VHF triode . . .

Is the industry's first subminiature tube for grounded grid amplifier applications. It offers very low heater power of 125mA @ 6.3V as much as 50% less than types with comparable Gm and Ib. Gm is 13,000 μmhos. 8071 exhibits a 2.5 to 7 db gain improvement 1.5 to 4 db noise improvement at 480mc than normally encountered with popular grounded-grid RF amplifier types.

Sylvania SR-2662A, medium-mu VHF double triode . . .

Features 26.5V heater and plate operation. Designed for use as a cathode-follower or RF amplifier-mixer in hybrid systems. In airborne or mobile equipment using a 26.5V energy source, SR-2662A eliminates the need for special plate and heater supply circuits enhancing equipment compactness and reliability. Per section Gm is 9,000 μmhos.

Examine the extraordinary performance advantages of Sylvani Strap Frame Grid Subminiature Tubes for your design. Ask you Sylvania Sales Engineer for full information, or write for technica data to Electronic Tubes Division, Sylvania Electric Products Inc 1100 Main St., Buffalo 9, N. Y.

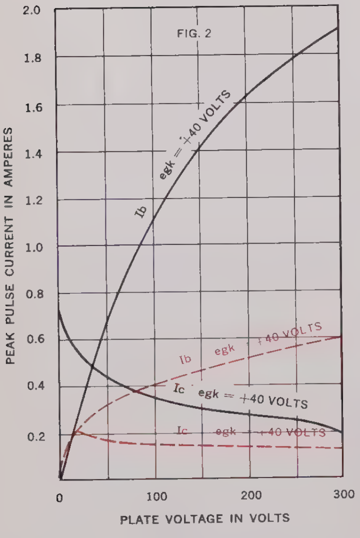


FIG. 2

Comparison of Positive Grid Voltage Plate Current Curves of 7963 (——) and 6111 (---).

FIG. 1

AVERAGE CHARACTERISTICS

	7962 double triode	7963 double triode	8070 triode	8071 triode	SR-2662A double triode	Units
Ef	6.3	6.3	6.3	6.3	26.5	V
If	235	350	125	125	90	mA
Eb	60	100	110	150	55	V
Rk	220*	270*	——	100	——	Ohms
Ib	9.0*	7.5*	9.0	13.0	5.0*	mA
Gm	9,500*	13,000*	11,000	13,000	9,000*	μmhos
Gm:Ib	1,055*	1,730*	1,222	1,000	1,800*	μmhos:mA
Mu	20*	40*	58	55.2	20*	

Noise-matched Conditions

	Grounded Cathode Circuit (200mc)			Grounded Grid (480mc)	RF Cascode Amp. (213mc)	
Gain	14.8*	15.1*	17.5	14.0	21*	db
BW	8.0*	9.5*	11.8	9.5	8.5*	mc
NF	4.0*	4.0*	4.4	7.2	6.4*	db

*SINGLE SECTION VALUES

How to predict reliability of end-equipment!

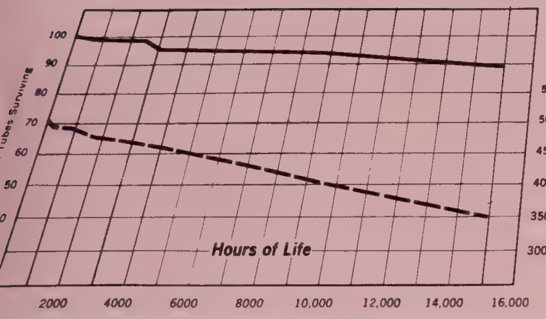


FIG. 4

6111 Survival curve for inoperatives through 15,000 hours (——). Median for Gm through 15,000 hours (– – –).

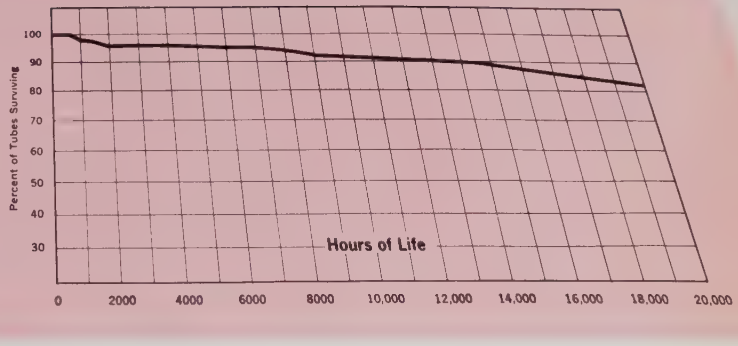


FIG. 3

5718 Survival curve for inoperatives through 20,000 hours.

A laboratory-proven design transferred to production line—then to actual field-use—may sometimes perform in an unexpected, erratic manner. Yet Management and Military are demanding increased assurances of reliability. How do you solve the dilemma for your design? One way: specify components offering documented, field-proven reliability.

Take the case for tubes. Tests by ARINC Research Corp.† illustrate the dramatic improvements in tube reliability since 1954. The results of tests conducted aboard naval vessels show a combined tube removal rate of 15% per 1000 hours in 1954. By 1960 this figure dropped to 1.2% for miniature tubes and a remarkable 0.19% for subminiature tubes. All the controlled subminiature types were *Sylvania* tubes.*

Survival tests by Sylvania (Figs. 3 & 4) on Gold Brand Subminiature types 5718 and 6111 demonstrate similar outstanding results. Sylvania-5718, UHF medium-mu triode, shows better than 90% survival at 12,000 hours. Sylvania-6111, medium-mu double triode, shows an average decline in Gm of only 2.4% per 1000 hours and better than 90% tube survival at 12,000 hours.

Further quantitative measure of reliability is provided by Sylvania acceptance criteria for Gold Brand Subminiature Tubes. Based on the average number of cumulative failures per 1000 hours for a 5-lot moving average, instead of the customary 1-lot, it offers a stringent control over an exceptionally wide range of production. And, it provides a highly accurate basis for statistical prediction of % failure rate in 1000 tube hours.

If you're being asked to predict reliability of your military or industrial design, call upon the expert assistance of Sylvania. Your Sylvania Sales Engineer will gladly supply detailed documentation of Gold Brand Subminiature Tube reliability.

*Sylvania-5636, 5644, 5647, 5718, 5719, 5840, 5899, 5902
The subminiature tubes were use-tested in SRR-13A receivers.

†Courtesy ARINC Research Corp. as published in publication #101-28-166, #101-26-160

MICROWAVE DEVICE NEWS from SYLVANIA

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75%
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PPM-FOCUSED TWT's

for operation from 1 to 12Gc

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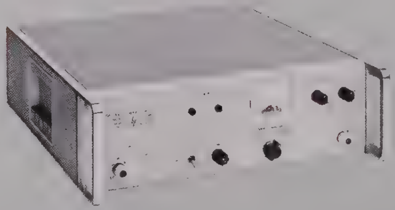
For further information contact your nearest Sylvania Sales Engineering Office, or write Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N.Y.

Frequency Range (Gc)	Sylvania Type	Power Output	Min. Gain (db)
1-2	TW-4267	15mW	35**
1-2	TW-4268	1W	30*
2-4	TW-4261	10mW	35**
2-4	TW-4260	1W	30*
4-8	TW-4281	10mW	35**
4-8	TW-4278	1W	30*
8-12	TW-4282	5mW	35**
8-12	TW-4273	1W	30*

**small signal gain *at saturation



Hewlett-Packard specified Sylvania TWT in the new versatile 1-Watt amplifiers, Models 489A (1 to 2 Gc) and 491C (2 to 4 Gc).

AT WESCON—see the Sylvania exhibit, Booth #3201, 3, 5, 7, 9, 11, 12, 3302, 4, 6, 8,

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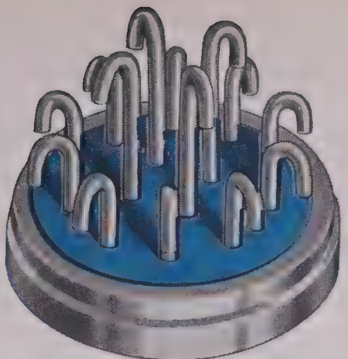

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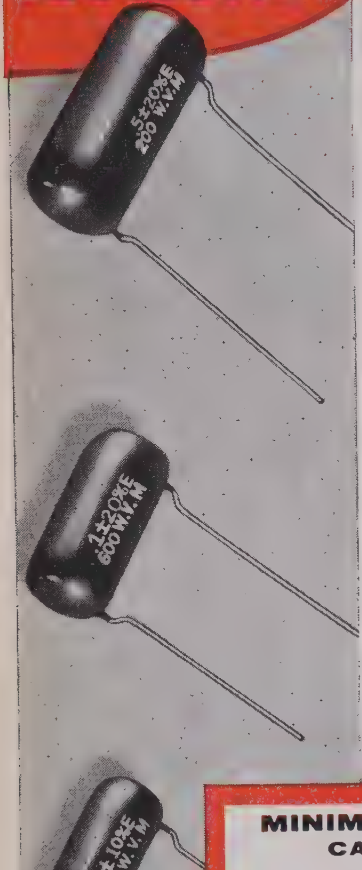

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CAPACITANCE AND VOLTAGE CHART

- *Five case sizes in working voltages and ranges:*

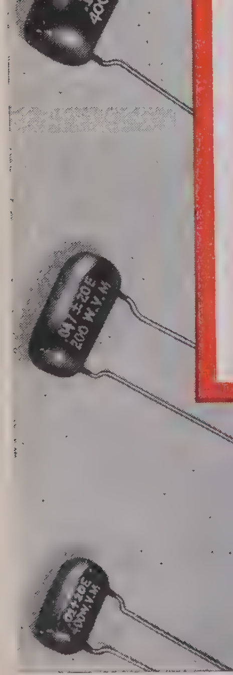
200 WVDC —	.018 to .5 MFD
400 WVDC —	.0082 to .33 MFD
600 WVDC —	.0018 to .25 MFD
1000 WVDC —	.001 to .1 MFD
1600 WVDC —	.001 to .05 MFD

SPECIFICATIONS

- TOLERANCES: 10% and 20%. Closer tolerances available on request.
- INSULATION: Durez phenolic, epoxy vacuum impregnated.
- LEADS: No. 20 B & S (.032") annealed copper clad steel wire crimped leads for printed circuit application.
- DIELECTRIC STRENGTH: 2 or 2½ times rated voltage, depending upon working voltage.
- INSULATION RESISTANCE AT 25°C: For .05MFD or less, 100,000 megohms minimum. Greater than .05MFD, 5000 megohm-microfarads.
- INSULATION RESISTANCE AT 105°C: For .05MFD or less, 1400 megohms minimum. Greater than .05MFD, 70 megohm-microfarads.
- POWER FACTOR AT 25°C: 1.0% maximum at 1 KC

These capacitors will exceed all the electrical requirements of E. I. A. specification RS-164 and Military specifications MIL-C-91B and MIL-C-25C.

Write for Technical Brochure



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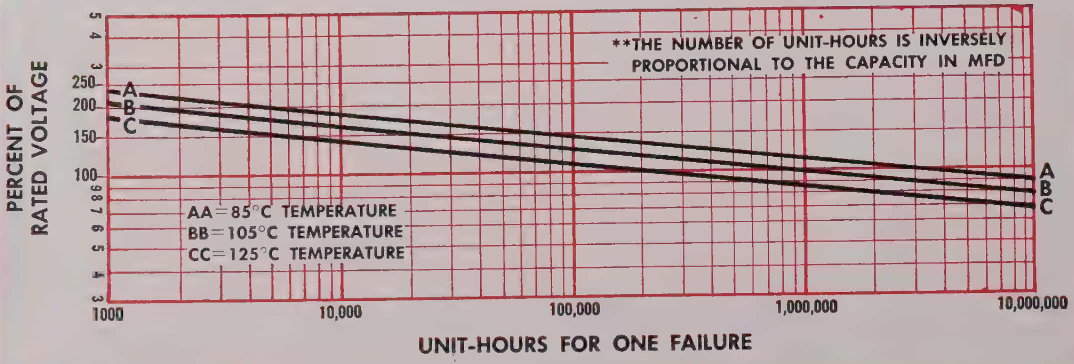

**THE NUMBER OF UNIT-HOURS IS INVERSELY PROPORTIONAL TO THE CAPACITY IN MFD

AA=85°C TEMPERATURE
BB=105°C TEMPERATURE
CC=125°C TEMPERATURE

*Registered Trade Mark of DuPont Co.

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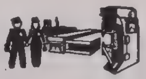
Sources

The CERN 600 MeV Synchrocyclotron at Geneva, I. Object and Design, W. Gentner. "Phil. Tech." #5, 1961. 8 pp. The synchrocyclotron of the CERN laboratory at Geneva, which has been in operation since August 1957, produces protons of 600 MeV. This article discusses briefly the principal considerations governing the choice of this energy and the general design. (Netherlands in English.)

The CERN 600 MeV Synchrocyclotron at Geneva, II. The Radio-frequency System, K. H. Schmitter and S. Kortleven. "Phil. Tech." #5, 1961. 13 pp. The RF system of the CERN synchrocyclotron, the main components of which are the resonator (dee system) and the RF generator, was developed and built by Philips Eindhoven in cooperation with CERN engineers. On the basis of theoretical considerations and experiments with three different models, a resonator was finally built whose resonant frequency is swept through the required range from 29 to 16.5 MC/s by means of a capacitance variation from 256 to 2580 pf of the modulation capacitor (tuning fork). The construction of the resonator and the measures taken to avoid mechanical strains are broadly described. (Netherlands in English.)

The CERN 600 MeV Synchrocyclotron at Geneva, III. The Tuning-fork Modulator. "Phil. Tech." #5, 1961. 19 pp. The frequency modulation of the CERN synchrocyclotron is effected by a capacitor made to vibrate at 55 c/s, which was developed by the Philips Eindhoven Laboratories in cooperation with the CERN. The capacitor comprises an aluminium "tuning fork" about 60 cm long and 2 meters wide. (Netherlands in English.)



INDUSTRIAL ELECTRONICS

Automatic Speed Control, C. Pontier. "El. et Auto." May 1961. 3 pp. This article describes a simple, rugged and reliable industrial circuit fully transistorized, which gives automatic speed indications. Its use can be extended to fields other than speed control. (France.)

Industrial Applications of Thermistors, J. C. Bonnaire. "El. et Auto." May 1961. 3 pp. Some reliable industrial circuits are described. They deal with temperature level alarm, temperature variation alarms, multirange thermometer. (France.)

Transductor Welding Equipments, Karl Kless and Eugen Renz. "AEG Prog." #7, 1961. 7 pp. The use of transductors for control and as power amplifiers in power supply apparatus for welding is described. (Germany in English.)

Industrial Applications of Solid Thyratrons, P. Chanut. "El. et Auto." March-April 1961. 4 pp. Solid Thyratrons, or controlled rectifiers, are particularly well suited to industrial circuits because of their high current and power ratings. They are rugged devices which can frequently be used with simple circuitry. Various examples of industrial applications of solid thyratrons are given. (France.)

Industrial Applications of Relay-Tubes, L. Vareille. "El. et Auto." May 1961. 3 pp. Cold-cathode relay tubes are particularly well suited to industrial circuits. Several typical applications are described. (France.)

Automatization of Machine-Tools, E. B. Miller. "El. et Auto." May 1961. 4 pp. Automatic control of machine-tools is based on simple logical operations which can be performed by elementary electronic circuits suitably interconnected. This paper describes three transistor logic circuits of the AND, OR and MEMORY types. (France.)

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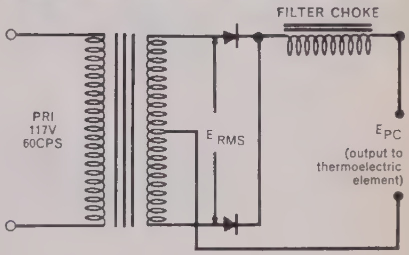

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CAPACITORS

The GENERAL INSTRUMENT CAPACITOR DIVISION enters the electronics world with 60 years of experience. Formed by a consolidation of Pyramid and Micamold, the new GENERAL INSTRUMENT CAPACITOR DIVISION combines Pyramid's 23 years of experience and Micamold's 37 years under one, new corporate roof.

What does this mean to you? ■ You now have a major new source for capacitors...with a product line that meets almost 100% of your capacitor requirements. **(You'll be especially interested in our Tantalums—Dipped Micas—Subminiature Electrolytics and Film Capacitors)**...with modern manufacturing and research facilities capable of handling everything from special high-reliability capacitors to high-quality, large production runs...with experienced and imaginative designers, engineers and technicians approaching each assignment from one point of view—yours!...with a nationwide staff of trained and experienced sales engineers ready to sit down at a moment's notice to help you work out your capacitor problems...with marketing and financial resources that insure a sound pricing policy, and prompt, reliable deliveries, not some of the time, not most of the time, but all the time. ■ Find out how this new "60-year old" source of capacitors can work for you. **Come see us at the WESCON Show, Booth 1912.** Write for engineering bulletins to GENERAL INSTRUMENT CAPACITOR DIVISION, Darlington, S.C.

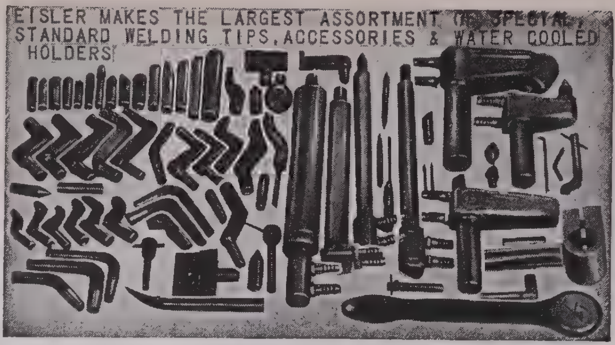
GENERAL INSTRUMENT CAPACITOR DIVISION
GENERAL INSTRUMENT CORPORATION

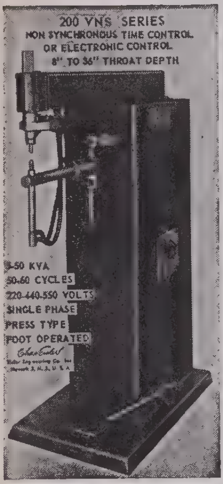
Circle 83 on Inquiry Card

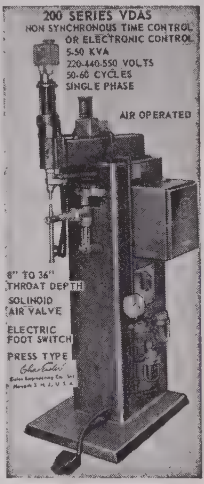
SPECIAL

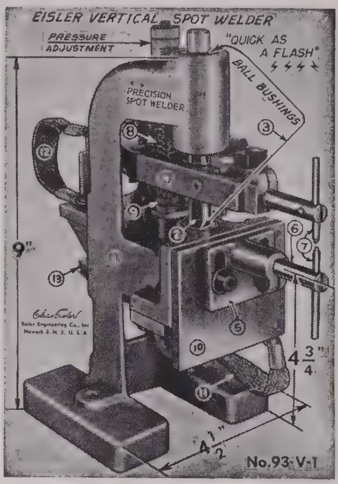
WELDING TIPS, HOLDERS and WELDING JIGS

MADE TO YOUR SPECIFICATIONS


EISLER MAKES THE LARGEST ASSORTMENT OF SPECIAL, STANDARD WELDING TIPS, ACCESSORIES & WATER COOLED HOLDERS







EISLER ENGINEERING CO., INC.

Write For Catalog W-61
770 So. 13th St., NEWARK 3, N. J.

Circle 95 on Inquiry Card

Gulfstreams Modified As Flying Laboratories

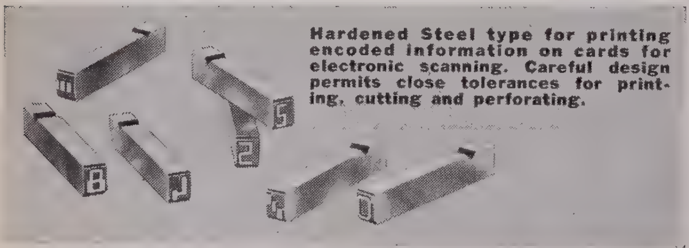
Modification work has begun on two Grumman Gulfstreams which will be outfitted as aerial laboratories for the F.A.A.-Performance tests on various navigational systems and air-borne systems will be conducted. The Garrett Corporation's AiResearch Aviation Service Division, Los Angeles, Calif., is converting the aircraft for Grumman Engineering Co. Grumman will contract the aircraft to the F.A.A. Research and Development Center, N.A.F.E.C., Atlantic City, N. J.

Electronics gear is being installed to equip the aircraft for carrying out their missions on schedule even in adverse weather conditions. This gear includes basic dual communications and navigation equipment, dual glide slope systems, single marker beacon system, weather radar system, ATC transponder, dual ADF, autopilot, integrated instrument system, dual compass system, TACAN system, audio isolation and interphone system, and dual flight instruments.

FORCE ENCODING AND NUMBERING UNITS FOR ELECTRONIC SCANNING SYSTEMS

Look to Force for the design and manufacture of numbering and encoding equipment in the very latest optical or magnetic printing systems. Rely on Force, a leader in the engraving and marking machine field for over 85 years for precision units.

Electronic scanning systems are changing the production techniques of industry and require the finest engraved assemblies available. That is why industry calls upon the experience and capacity of Wm. A. Force & Co. in the early stages of research and development. Here are some of the recent encoding units developed by Force for either optical and/or magnetic scanning systems:



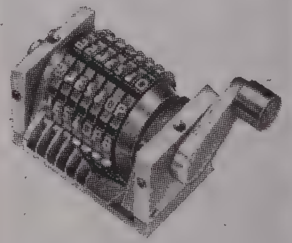
Hardened Steel type for printing encoded information on cards for electronic scanning. Careful design permits close tolerances for printing, cutting and perforating.

EMBOSSING TYPE, ENGRAVED WHEELS AND COMPONENTS

Used to imprint accounting records and similar documents for scanning.

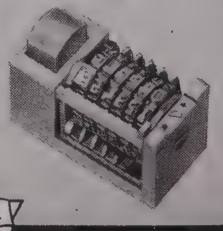
FLAT BASE MALE DOVETAIL STRAIGHT ROTARY HEADS

A versatile numbering head that mounts on a removable adapter block and can be used on rotary presses of any circumference. It accepts from 2 to 9 or more wheels containing E13B Bank Automation Figures or other special shapes or designs. Straight or Convex Heads available on order.



NUMBERING HEADS

Numbering heads for platen and flatbed cylinder presses. Available with a special Bank Automation Figure ... Forward or Backward.



Write for more information on the Force numbering and encoding solution applicable to your problem.

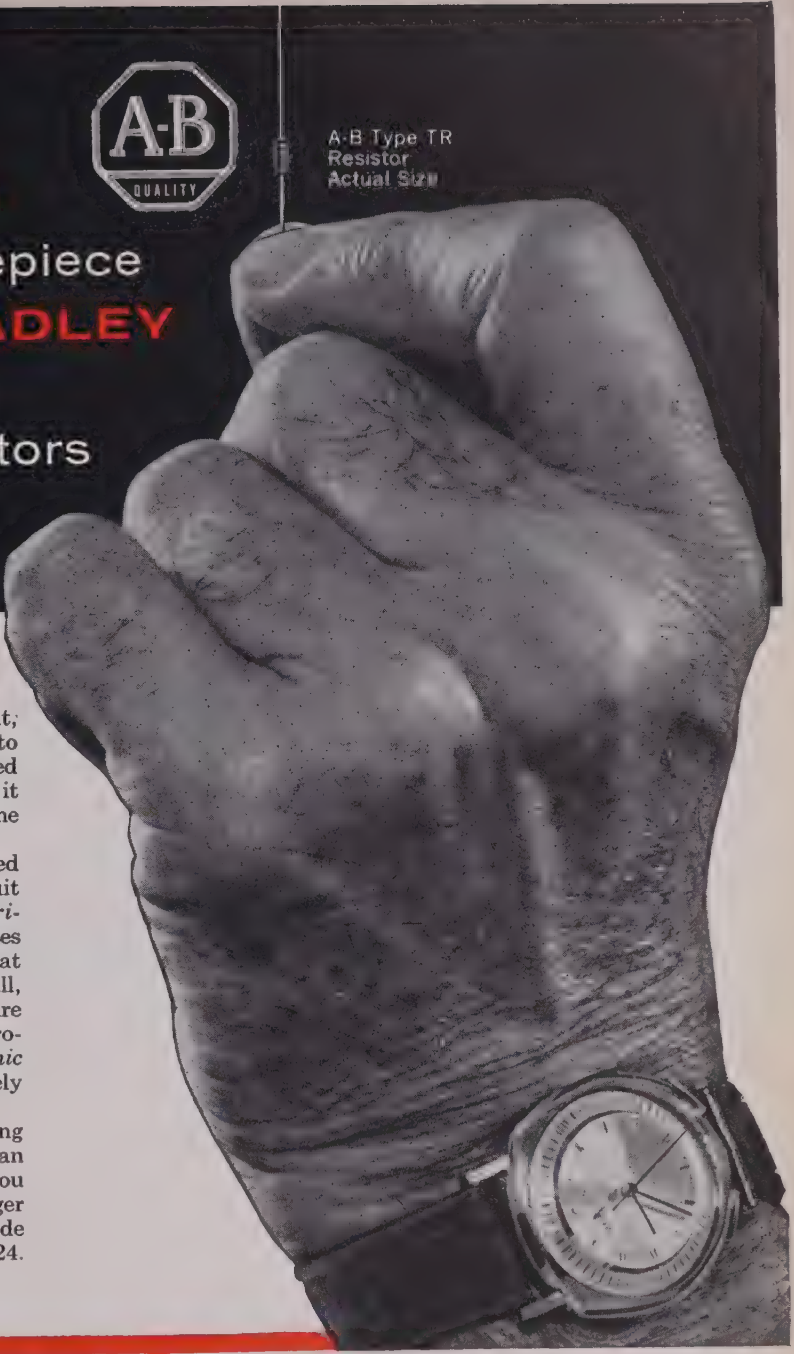
WM. A. **FORCE** & CO., Inc.
216 Nichols Ave.
Brooklyn 8, N. Y.

The FORCE OF NUMBERS

Circle 84 on Inquiry Card

Accutron*...

new electronic timepiece uses ALLEN-BRADLEY Type TR Miniature Composition Resistors



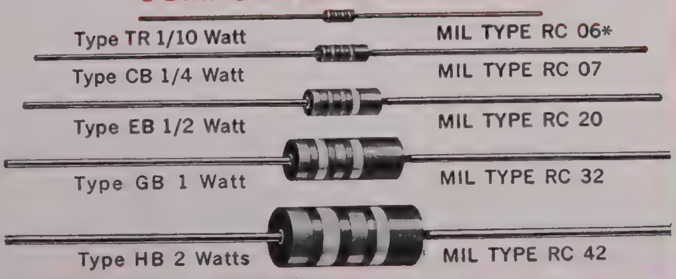
With its miniature tuning fork and electronic circuit, Accutron introduces an entirely new principle to timekeeping—one which promises unprecedented wrist timepiece accuracy. Strapped to your wrist, it is guaranteed not to gain or lose more than one minute a month.

Allen-Bradley Type TR tiny resistors enabled Accutron designers to achieve the required circuit miniaturization for a wrist timepiece—*without sacrificing reliability*. This circuit controls the 360 pulses of power each second—31 million per day—that drive the tuning fork. Although incredibly small, these Type TR miniature composition resistors are made by Allen-Bradley's exclusive hot molding process that *guarantees complete freedom from catastrophic failures!* A-B Type TR resistors are conservatively rated 1/10 watt at 70°C.

There are also other Allen-Bradley space-saving potentiometers, capacitors, and h-f filters that can help solve your miniaturization problem. And you obtain the same reliability for which the larger Allen-Bradley components have earned a world-wide reputation. For full details, send for Publication 6024.

* TRADEMARK BULOVA WATCH CO., INC.

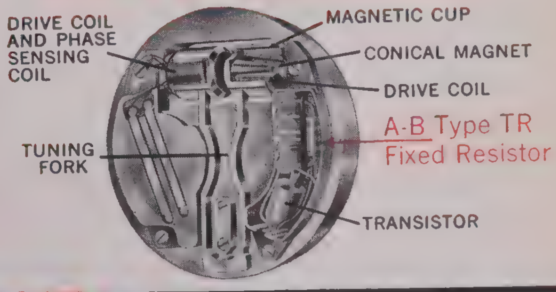
A-B HOT MOLDED COMPOSITION RESISTORS



Type TR 1/10 Watt	MIL TYPE RC 06*
Type CB 1/4 Watt	MIL TYPE RC 07
Type EB 1/2 Watt	MIL TYPE RC 20
Type GB 1 Watt	MIL TYPE RC 32
Type HB 2 Watts	MIL TYPE RC 42

*Pending MIL Spec Assignment

DRAWING OF ACCUTRON SHOWS BASIC MECHANISM

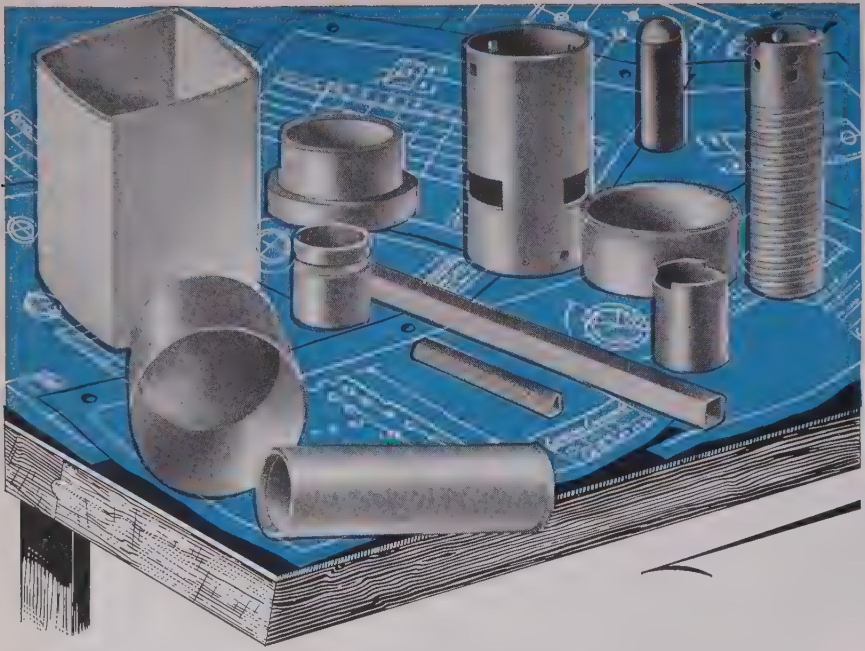


ALLEN-BRADLEY

Quality Electronic Components

Allen-Bradley Co., 1342 South Second Street, Milwaukee 4, Wisconsin • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

Circle 85 on Inquiry Card



ROUND OR RECTANGULAR
LONG SHORT THICK THIN
PUNCHED SLOTTED THREADED EMBOSSED

CLEVELITE*

In *every* way CLEVELITE is the *favorite* phenolic tubing. It is made in seven grades to assure dependable performance in any application.

CLEVELITE is unaffected by oils and solvents, is easily machined, light in weight, yet mechanically strong.

Dependable because of its non-tracking and insulation resistance . . . low moisture absorption . . . dielectric strength 150 v.p.m. . . . heat resistance over 250° F. . . . diameters and wall thicknesses as required.

WRITE FOR OUR LATEST CLEVELITE BROCHURE
fully outlining its electrical and physical characteristics and many applications.

*Reg. U. S. Pat. Off.

PLANTS & SALES OFFICES:
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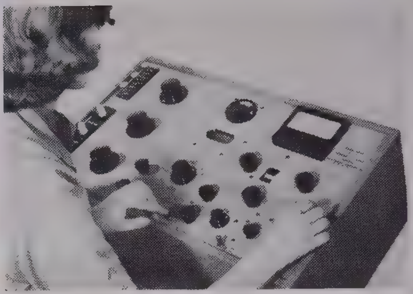
PHILADELPHIA: MIDLANTIC SALES CO.
9 E. ATHENS AVE., ARDMORE, PA.
LOS ANGELES AREA: THE ROBISON CO.
4026 W. 183rd ST., TORRANCE, CALIF.
CANADA: PAISLEY PRODUCTS CO. LTD.
36 UPTON RD., SCARBOROUGH, ONT.

Circle 63 on Inquiry Card

WESCON New Products



Measurement Standard

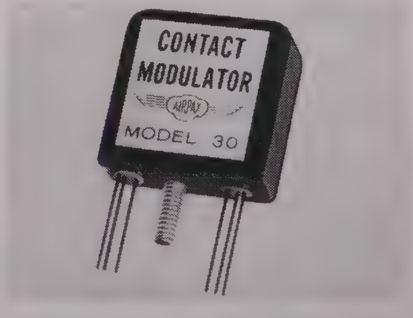
Model 1605A AC-DC Calibration/-Transfer Standard is a voltage and current measuring instrument for mobile or field use. Radio Frequency Laboratories, Inc. BOOTH 2912
Circle 296 on Inquiry Card

Current Shunt

Model HCS-1 for use where high accuracies are desired over a broad freq. range. Accuracy of ac-dc difference above 5 CPS and below 50 KC to 0.02%. Holt Instrument Laboratories. BOOTH 3305
Circle 297 on Inquiry Card

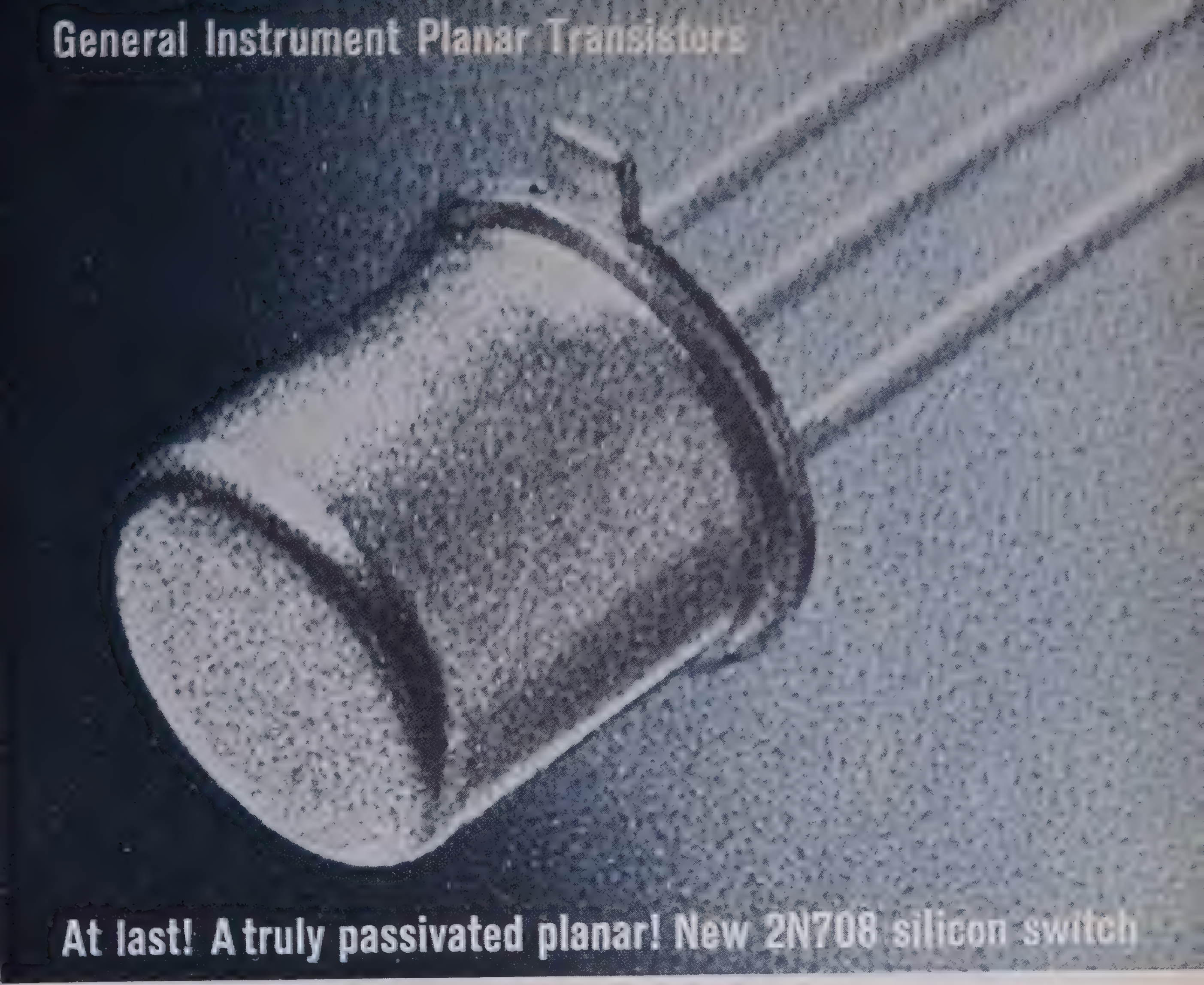
Now Noise Chopper

Model 30 eltcoro-mechanical chopper maintains minimum chopper noise level. It is for printed circuit use. Size: ⅝ x 21/32 x 21/64 in. This 60 CPS chopper is ruggedly built. Airpax Electronics Inc. BOOTH 1716



Circle 298 on Inquiry Card

General Instrument Planar Transistors



At last! A truly passivated planar! New 2N708 silicon switch

For high speed logic switching with assured reliability, the General Instrument 2N708 npn silicon planar switch features the unique Molecular Shield™ surface-passivation process. ■ Here's a planar that is stable, reliable and uniform...lot by lot...with excellent gain characteristics as well as extremely low leakage current. Designed for switching applications, this type, as well as others in the popular 2N706 class, utilizes the latest planar techniques. ■ Extensive tests have proved that this type of transistor construction offers definite circuit advantages. Life tests, for example, indicate little degradation as a result of operation and storage at high temperatures. ■ The immediate availability of the 2N706 series in production quantities should be of interest to designers now using our silicon mesa transistors. The 2N708 is also available in limited quantities. For microtransistors, pancake-package transistors...for all your silicon planar and mesa transistors, call the sales office or franchised distributor nearest you. Or write for complete details to General Instrument Semiconductor Division, 65 Gouverneur St., Newark 4, N. J.

Abbreviated Specifications—General Instrument NPN Silicon Planar Transistors

Type	V_{CBO}	V_{CER}	h_{FE}	τ_s
2N706	25v	20v	20	60 nsec
2N706A	25v	20v	20	25 nsec
2N706B	25v	20v	20	25 nsec
2N708	40v	20v	30	25 nsec

Circle 87 on Inquiry Card

JEDEC TO-18 CASE ACTUAL SIZE

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION
GENERAL INSTRUMENT CORPORATION

ACCURACY | STABILITY 0.0025%

OIL-FILLED

HERMETICALLY SEALED

MEET MIL SPECS

JRL

NEW Miniaturized PRECISION/STABLE Wire Wound Resistors

"PRECISION/STABLE" RESISTORS MADE *BEST VALUE* by

- savings from shorter lead time
- reduced equipment rejects
- reduced customer rejects

— be pound wise and penny foolish

FAILURE ANALYSIS OF REJECTED "PRECISION" RESISTORS*

31% rejected after assembly into networks.

8% rejected after 100-hour complete computer test.

24% rejected after amplifier was assembled and tested.

14% rejected on incoming inspection.

15% rejected after 50-hour "burn-in" of amplifier.

8% rejected in first 6 months of computer use after installation.

*Documented failure analysis as recorded by conventional "Precision" Resistor, despite acceptable initial accuracy for production-model analog computer.

Accuracy is extremely important when you're specifying resistors — and the Stability of that accuracy is as important for your customers. Rejections due to lack of stability at assembly stage and at final test are intolerably costly in time, money and customer satisfaction. Julie Research has successfully developed another first — a new standard in practical resistor manufacture, "Precision Stable" wire wound resistors with 0.0025% absolute accuracy and 0.0025% stability per year. This CH-1 resistor is a miniaturized production-model of larger laboratory-type resistors. Does reliability cost more — or do failures?

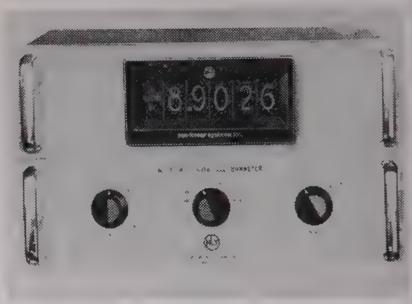
Write for JRL short form catalog, showing complete line of Precision/Stable resistors, 0.0015% to 0.05% and Precision/Stable laboratory standards.

JRL JULIE RESEARCH LABORATORIES INC.

603 West 130th St., New York 27, N. Y.

Circle 88 on Inquiry Card

WESCON New Products



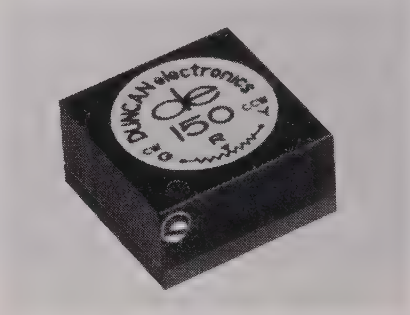
Volt-Ohmmeter

Transistorized, full five-digit meter, Model M25, measures voltage with accuracy of ±0.01% of reading ±1 digit in specified ranges. Control functions can be remotely operated. Non-Linear Systems, Inc. BOOTH 1518

Circle 293 on Inquiry Card

Trimming Pot

Series 150 covers 10 to 50K Ω resistance range. Subminiature ½ in. square trimmer features anodized aluminum housing, gold plated terminal pins and side adjusting screw. Duncan Electronics, Inc. BOOTH 808



Circle 294 on Inquiry Card

Signal Sources

The PRD 712 series are broadband general purpose generators of microwave signals. Continuous-wave sinewave, squarewave, and pulse-modulated signal outputs are available. PRD Electronics, Inc. BOOTH 2109

Circle 295 on Inquiry Card

Circle 89 on Inquiry Card ⟶

NEW METAL FILM CERAMIC ENCLOSED RESISTORS

MEPCO, the quality and quantity leaders in sealed carbon film resistors, introduces two new metal film units. These styles, the RN65C and RN70C, have been tested and meet all the requirements of characteristics C and E of MIL-R-10509D.

New manufacturing techniques now make it possible to offer the added advantages of a ceramic enclosure with the same economies presently available in molded and dipped types.

SPECIFICATIONS

RN65C*

FE 25 Rating		¼ W @ 125°C
Resis. Range		100Ω to 500 K
Resis. Tolerance		Down to ±.1%
Temp. Coeff.	**C1**)	±100 PPM/°C
	***C2**)	±50 PPM/°C
	C3)	±25 PPM/°C
	C4)	±15 PPM/°C
Dimensions		Length - .640 ±.010
		Dia. - .243 ±.005
		Leads - 1½" #22 A.W.G.

RN70C*

FE 50 Rating		½ W @ 125°C
Resis. Range		100Ω to 1 meg.
Resis. Tolerance		Down to ±.1%
Temp. Coeff.	**C1**)	±100 PPM/°C
	***C2**)	±50 PPM/°C
	C3)	±25 PPM/°C
	C4)	±15 PPM/°C
Dimensions		Length - .830 ±.010
		Dia. - .245 ±.010
		Leads - 1½" #20 A.W.G.

(TC's measured over temperature range of −55°C to +165°C)

MEPCO, INC.
Morristown, New Jersey

MEPCO

Manufacturers of Precision Resistors

(advertisement)

Radio Frequency Interference ...and What to Do About It

ICFS personnel brave the elements as they run a series of tests for one of their customers.

A PLANE, flying on autopilot, mysteriously veers off course and causes a tragic mid-air collision. Premature second-stage firing spoils a multi-million-dollar missile launching. A switch transient on the power line to a computer fouls up the digital pulse and suddenly two and two equal five! These are typical manifestations of radio frequency interference—major problem of electronic designers and engineers!

Until recently, controlling interference was a cut-and-try, retrofit operation — time-consuming, often unsatisfactory, almost always highly expensive. But now modification of existing equipments has given place to relatively precise prediction and pre-control of interference in the design phase!

Sprague's unique Interference Control Field Service is the leading exponent of this far more efficient, economical technique. Active in the field of interference since World War II, Sprague takes a bilateral approach to interference control problems. In 3 Sprague laboratories, strategically located in various parts of the country, interference measurement and prototype facilities are in constant use by customers who bring their equipment for evaluation, modification and qualification. And in addition, Sprague puts competent Interference Control Specialists at the service of companies whose products must meet stringent interference specifications, but who cannot be sure that they will.

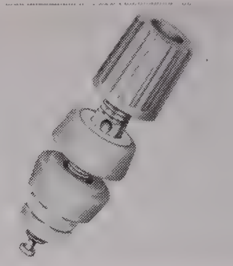
Interference prediction techniques developed over a period of years are successfully applied by Sprague specialists. Studying electrical schematics and mechanical layouts at customers' plants, Sprague engineers design into these pre-prototype plans the suppression and shielding which assure compliance with interference specifications. This activity usually costs far less than conventional modification of existing equipments.

Current assignments of Sprague Interference Control Specialists include a leading aircraft company, a nationally known manufacturer of radio telescope control mechanisms, the producer of an important missile component, and a huge corporation engaged in developing data link and telemetry systems for the Dyna-Soar program.

Whether *your* interference problem involves military or commercial electronic equipments, Sprague's Interference Control Field Service can speed and simplify solution. Preliminary discussion involves no obligation. For full information, contact the Sprague Interference Control Field Service Department, Sprague Electric Company, 233 Marshall St., North Adams, Mass.

Circle 90 on Inquiry Card

WESCON New Products



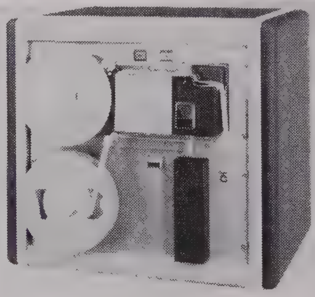
Binding Posts

Fluted nut, 5-Way Binding Posts feature Lexan$^{T.M.}$ polycarbonate resin molded parts. Properties include low loss and power factor; low dielectric constant; and high voltage insulation. Superior Electric Co. BOOTH 1312

Circle 290 on Inquiry Card

Tape Perforator

Medium speed unit for all paper or mylar tape punching requirements for business systems and the fields of data handling, reduction, processing and storage. Telecomputing Corp. BOOTH 2022

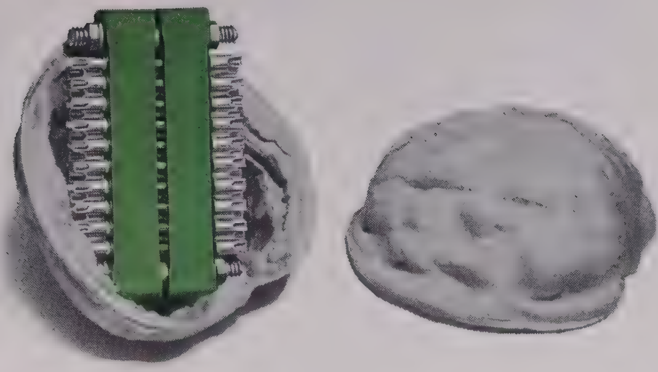


Circle 291 on Inquiry Card

Wattmeter

Termaline® R-F Wattmeter and Load is available in milliwatt ranges. Model 6254 measures power out and terminates low power 50Ω systems. The Bird Electronic Corp. BOOTH 1922

Circle 292 on Inquiry Card



geared for physical and astro-physical space

In a nutshell: U. S. Components' tiny UMI connectors are suitable for down-to-earth as well as space applications. Shown actual size is the 29-contact connector in the new Ultra-MIniature Series of connectors by U. S. Components. Available in eleven standard sizes with 5, 7, 9, 11, 14, 20, 26, 29, 34, 44 or 50 contacts accommodating up to No. 22 AWG wire, the UMI Series furnishes quality performance in the *smallest package* available today. Reliability is assured even under unusual mechanical, electrical, and environmental stresses. Supplied in standard draw-pull and screwlock units. Bodies are molded in glass-filled Diallyl Phthalate meeting MIL-M-19833. Other materials upon application. Complete design information and specifications upon request. Patent No. 2,761,108.

U. S. COMPONENTS, INC., 1320 Zerega Avenue, New York 62, N. Y., Telephone: TA 4-1600

TERMINAL BLOCKS • SWITCHES • CONVENIENCE OUTLETS

• Just clip on wire terminal fast—for a tight connection • Disconnect just as fast • Available on KULKA'S full line of molded barrier terminal blocks, plus switches and convenience outlets • Up to 6 connections per stage • Vari-angled tabs • Available riveted to terminal hardware or with screw assembly • Designed to accept female wire terminals made by AMP, BURNDY, KENT, and ARKLES.

For fast, reliable wire hook-up — and quick disconnect — KULKA'S versatile "Kliptite" terminals are unbeatable. That's why they are specified by leading manufacturers of appliances, air conditioners, vending machines, and countless other types of equipment. "Kliptite" male tabs are electro-tinned brass for low contact resistance. They may be supplied rigidly riveted to KULKA terminal hardware, or where termination to a screw is required on the same terminal, they may be assembled under the screwhead.

See for yourself how "Kliptite" terminals can improve your assembly operation.

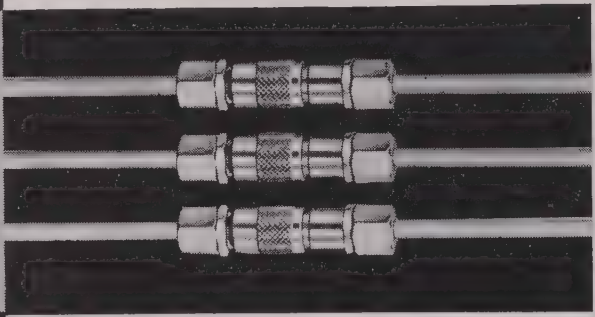
Write for complete details . . .

KULKA ELECTRIC CORP.
633-643 SO. FULTON AVENUE, MOUNT VERNON, N. Y.

Circle 92 on Inquiry Card

DAGE CUB series
SUBMINIATURE RF CONNECTORS

proven reliability *in miniature*



BOOTH 2918 AT WESCON SHOW

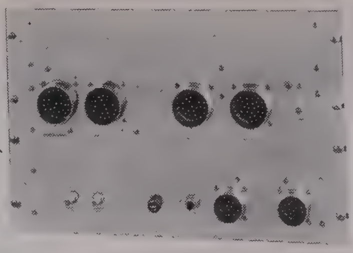
DAGE "CUB" Series is designed to meet the toughest commercial and military requirements for small, lightweight connectors, Less than *half the size* of standard BNCs.

- Impedance Matched
- Positive Electrical Contact
- Superior Mechanical Strength
- Excellent Insulation
- Weather-Proof
- All Standard Fittings

Write for Detailed Specifications.

DAGE
DAGE ELECTRIC COMPANY, INC.
67 NORTH SECOND STREET
BEECH GROVE, INDIANA

WESCON New Products



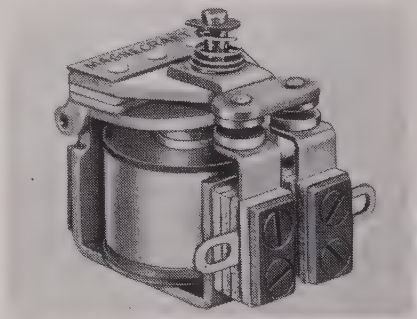
Pulse Generator

Model B-11, Remotely Programmable Pulse Generator is for automated checkout systems. It may be programmed to give an output pulse repetition rates from 20 pps to 2 million pps. Rutherford Electronics Co. BOOTH 1501

Circle 287 on Inquiry Card

Power Relay

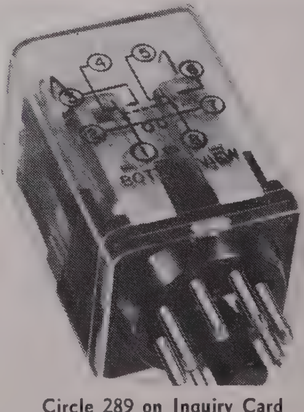
AC/DC Unit, Class 88D, has 50 a. contacts, SPST, NO or NC, double break, with heavy duty silver alloy points. Fiber glass insulated for switching high currents in small space. Magnecraft Electric Co. BOOTH 3017



Circle 288 on Inquiry Card

Impulse Relay

Unit has high vibration immunity and low power requirements. It is an overload interrupter for protecting transistor and a low cost, general purpose ac-dc relay. Signa Instruments, Inc. BOOTH 520.



Circle 289 on Inquiry Card

Circle 93 on Inquiry Card

124 completely hermetically sealed Microwave Mixer and Video Diodes

ALL ARE DIRECTLY SUBSTITUTABLE FOR CONVENTIONAL DIODES TO ASSURE UNPRECEDENTED SYSTEMS RELIABILITY.

EXCLUSIVE MICROWAVE ASSOCIATES METAL-TO-CERAMIC SOLDER SEAL

Microwave Associates has answered your need for truly hermetically-sealed diodes. For the first time, both fixed-base and reversible polarity types have CERAMIC-TO-METAL SOLDER SEALS plus SOLDER END SEALS.

Whatever the requirement – from 1 Mc to 18 kMc, a new diode is available to replace the present diode — extra high burnout types for high signal level circuits and behind radar duplexers—new low-noise types for doppler receivers.

The MA-458F, for example, replacing the 1N23E, has a calculated overall noise figure of 7.0 db — the lowest noise figure available for high reliability applications.

These diodes (and coaxial case and subminiature glass packaged diodes) assure military and commercial applications the reliability essential to uninterrupted service for exceptional time spans. They perform to 150°C and meet the applicable environmental requirements of MIL-S-19500.

MICROWAVE ASSOCIATES, INC
SEMICONDUCTOR DIVISION
BURLINGTON, MASSACHUSETTS • WESTERN UNION FAX
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SILICON MIXER DIODES

1 Mc — 4,000 Mc

CARTRIDGE CASE

Improved Types
For low noise superheterodyne mixer performance
• Replace 1N21 series

Fixed Base Types		Matched Pair		Reversible Polarity Types	Calc. Overall Rec'r Noise Figure N., 1.5db (db)	Burnout Rating (ergs)
Forward Polarity	Reversed Polarity	Forward Pair	Forward & Reversed			
MA-449B	MA-449BR	MA-449BM	MA-449BMR	MA-459B	10.3	5.0
MA-449C	MA-449CR	MA-449CM	MA-449CMR	MA-459C	8.1	5.0
MA-449D	MA-449DR	MA-449DM	MA-449DMR	MA-459D	7.3	5.0
MA-449E	MA-449ER	MA-449EM	MA-449EMR	1N21WE	7.0	5.0
MA-449F	MA-449FR	MA-449FM	MA-449FMR	MA-459F	6.0	5.0

Higher Burnout Types
For use in pulse radars or other receivers exposed to high RF radiation fields.
• Interchangeable with 1N21 series

MA-4127	MA-4127R	MA-4127M	MA-4127MR	MA-4132	8.3	10

Lower Noise Types
For best signal-to-noise performance in low frequency IF doppler systems.

MA-4126	MA-4126R	MA-4126M	MA-4126MR	MA-4131	–	2.0
MA-4126A	MA-4126AR	MA-4126AM	MA-4126AMR	MA-4131A	–	2.0

4,000 Mc — 10,000 Mc

Improved Types
For low noise superheterodyne mixer performance.
• Replace 1N23 series

MA-451B	MA-451BR	MA-451BM	MA-451BMR	MA-458B	11.4	2.0
MA-451C	MA-451CR	MA-451CM	MA-451CMR	MA-458C	9.8	2.0
MA-451D	MA-451DR	MA-451DM	MA-451DMR	MA-458D	8.2	2.0
MA-451E	MA-451ER	MA-451EM	MA-451EMR	IN23WE	7.5	2.0
MA-451F	MA-451FR	MA-451FM	MA-451FMR	MA-458F	7.0	2.0

Higher Burnout Types
For use in pulse radars or other receivers exposed to high RF radiation fields.
• Interchangeable with 1N23 series

MA-4133	MA-4133R	MA-4133M	MA-4133MR	MA-4134	9.8	5.0

Lower Noise Types
For best signal-to-noise performance in low frequency IF doppler systems.

MA-4125	MA-4125R	MA-4125M	MA-4125MR	MA-4130	—	2.0
MA-4125A	MA-4125AR	MA-4125AM	MA-4125AMR	MA-4130A	—	2.0

10,000 Mc — 18,000 Mc

COAXIAL CASE

Improved Types
For low noise superheterodyne mixer performance.
• Replace 1N78 series

MA-433	MA-443R	MA-443M	MA-443MR	—	—	0.6
MA-443A	MA-443AR	MA-443AM	MA-443AMR	—	9.6	0.6
MA-443B	MA-443BR	MA-443BM	MA-443BMR	—	8.8	0.6
MA-445	MA-445R	MA-445M	MA-445MR	—	—	1.0
MA-445A	MA-445AR	MA-445AM	MA-445AMR	—	9.5	1.0
MA-445B	MA-445BR	MA-445BM	MA-445BMR	—	8.8	1.0

Lower Noise Types
For best signal-to-noise performance in low frequency IF doppler systems.

MA-4124	MA-4124R	MA-4124M	MA-4124MR	—	—	0.6
MA-4124A	MA-4124AR	MA-4124AM	MA-4124AMR	—	—	0.6

SILICON VIDEO DIODES

1 Mc — 10,000 Mc

Improved Types For high tangential signal-to-noise sensitivity in simplified beacon receivers, test equipment and other uses.
• Replace MA-408 series CARTRIDGE CASE

Fixed Base Types		Reversible Polarity	Burnout (ergs)
Forward Polarity	Reversed Polarity		
MA-452 MA-452A MA-452B	MA-452R MA-452AR MA-452BR	MA-461 MA-461A MA-461B	1.0 1.0 1.0

Higher Burnout Wide Dynamic Range Types
For use in video receivers exposed to high RF radiation fields.
• Interchangeable with MA-408 series

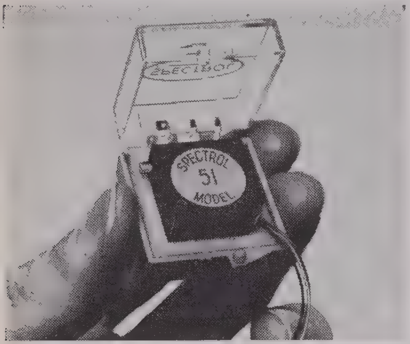
MA-4128	MA-4128R	MA-4129	5.0

Circle 94 on Inquiry Card

New Products

TRIMMER POTENTIOMETER

Model 51 has coated leads and is humidity proofed.



Surface contact between the mandrel and aluminum case allows unit to dissipate its 3 w rated power without an external heat sink or additional hardware. Available in ranges from 50 to 200 K Ω and weighs 5 g. It meets or exceeds military specs. for altitude, fungus, salt spray, humidity, sand and dust, temp. cycling, shock and vibration, and immersion/Mil-STD-202B, Method 104A, Condition A. Spectrol Electronics Corp., 1704 So. Del Mark Ave., San Gabriel, Calif.

Circle 299 on Inquiry Card

TELEMETERING TRANSDUCER

Potentiometer pressure transducer used in severe environments.

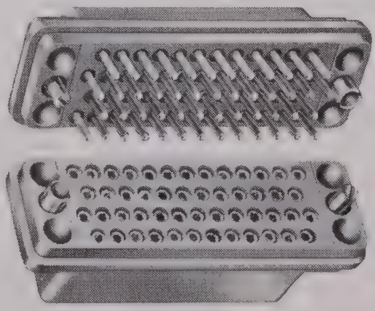
The 4½ oz. unit functions with less than ±1% instantaneous ac error during vibration of 50 G to 2,000 CPS. Acceleration shift is less than 1% at 100 G, and the unit is undamaged by 500 G acceleration. Sensing element is a precision Ni-Span-C® Bourdon tube with balanced mechanical system to provide immunity to vibration and stability of 0.01%/F° over the range from −65°F to +350°F. Control Components Div., International Resistance Co., 401 N. Broad St., Phila., Pa. Circle 300 on Inquiry Card

new GEN-PRO®

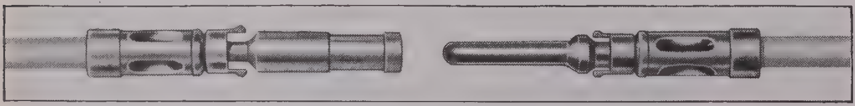
REPICON® REMOVABLE CONTACT CONNECTOR

New from Gen-Pro: Repicon "C" high density removable contact connector offers unlimited application in writing installations. Available in 34, 42, 50, 75 and 104 contacts. In accordance with requirements of MIL-C-22857; interchangeable with other connectors of MIL-C-8384 configuration and contact pattern.

Repicon Removable Contacts in crimp or solder type give higher contact retention, closely controlled engagement and separation forces and low millivolt drop. Usable in other existing connector body sizes and configurations. Contacts are ordered separately for assembly by user.



TYPE C
50 CONTACTS



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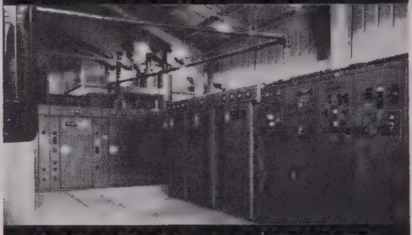
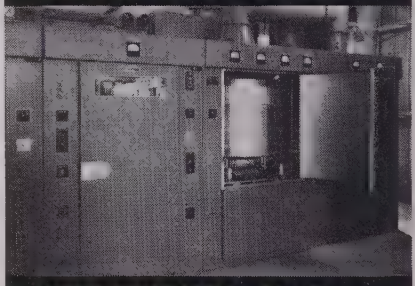
The "Big Dish" taking shape at Stanford University



Oscillator-Modulator and 16KW/32KW VHF Amplifier Group

100KW/50KW VHF Amplifier Group



600KW/300KW VHF Amplifier Group

The Oscillator-Modulator group and the 16KW/32 KW VHF group has a frequency range of 20-65 megacycles and is continuously tunable. This is used to drive either the 50KW/100KW VHF amplifier group which is designated CEMC Type 818 (AN/FRT-34), or the 300KW/600KW VHF amplifier group which is designated CEMC Type 821 (AN/FRT-32). This high power VHF transmitting equipment was developed under a contract with the Army Signal Corps.

The radar unit is a joint project of the University's Radioscience Laboratory and Stanford Research Institute's Communications and Propagation Laboratory, with support from the Air Force Cambridge Research Laboratory.

Continental Electronics
MANUFACTURING COMPANY
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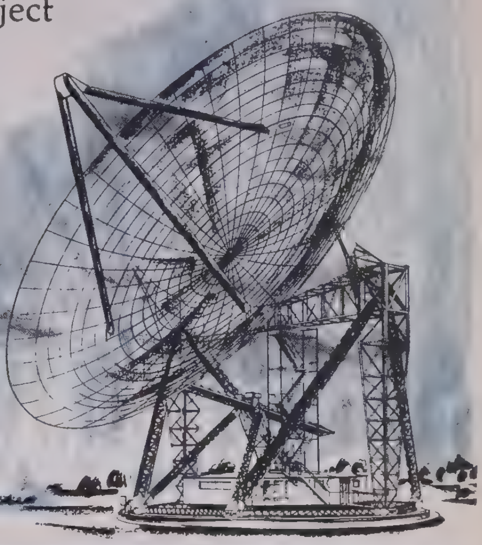
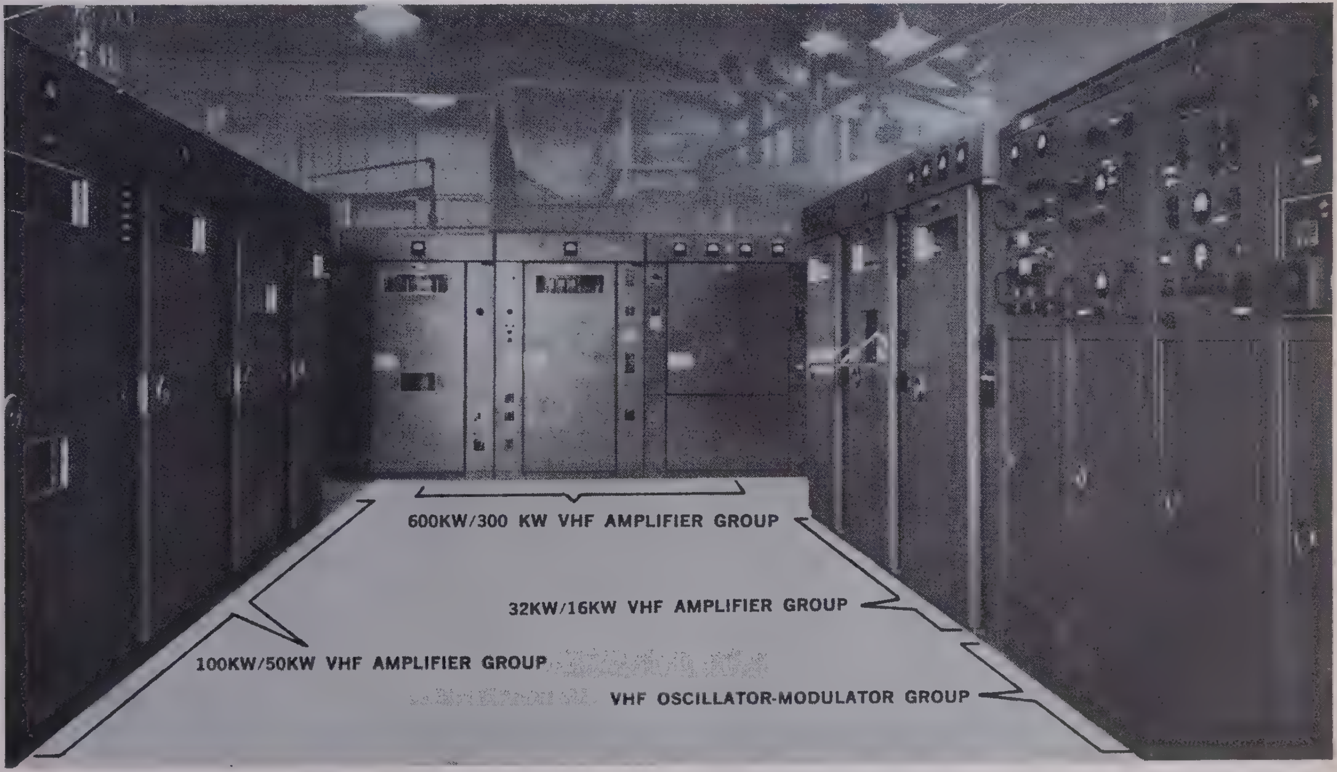
SEE IT AT WESCON
Take Tour #3
Wed. Aug. 23

Standing atop the ridge of hills at the back of the Stanford University campus is a 15-story dish antenna, a joint project of Stanford Research Institute and the University. The 150-foot parabolic reflector is illuminated by a Continental Electronics high power, very high frequency transmitting equipment, and is part of one of the finest radar astronomy establishments in the world. Another example of Continental's continuing leadership in super power transmitting equipment.




600KW/300 KW VHF AMPLIFIER GROUP
32KW/16KW VHF AMPLIFIER GROUP
100KW/50KW VHF AMPLIFIER GROUP
VHF OSCILLATOR-MODULATOR GROUP

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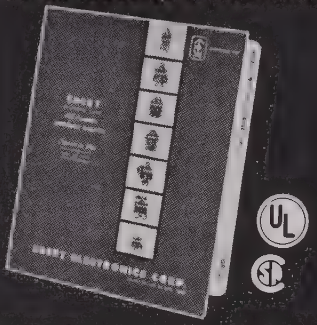

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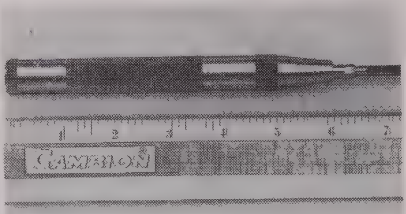
New Products

INSERT-EXTRACT TOOL

Insertion and extraction tool is for taper pin terminals.

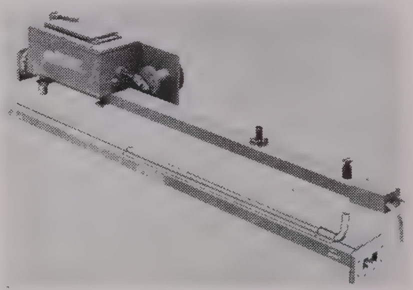


The main feature of this new tool, designated as Cambion No. 3060, is the ability to both insert and extract taper pins with the single instrument. Rolled from mild steel and knurled at the handle for easy gripping, the tool measures 7½ in. overall. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

Circle 301 on Inquiry Card

MAGNETRON TESTING LOADS

Provide termination/load of low VSWR *for Magnetron output system.*



Loads are available as shown with or without the variable phase Magnetron pulling slug, and may be pressurized to 30 psig. If desired, the pulling slug can have a motor drive unit for continuous phase variation. Seven types are available, in freq. ranges from 2.6 to 71.0 GC. Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.

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New

JONES 2400 SERIES
PLUGS & SOCKETS

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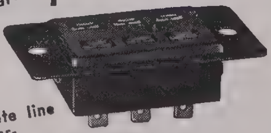
Ask for Catalog 22. Complete line Jones Plugs, Sockets, Terminal Strips.

P-2406-CCT
Plug—with Cable clamp in top



S-2406-SB
Socket with shallow bracket for flush mounting.

Jones
HOWARD B. JONES DIVISION
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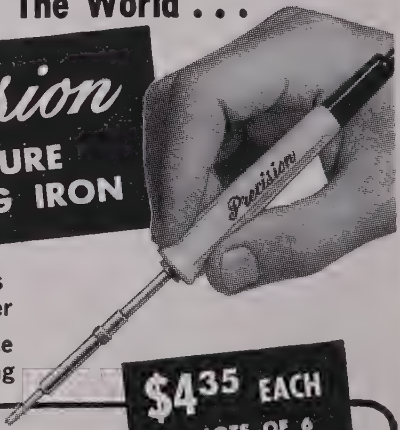
The Best Miniature Soldering Iron In The World . . .



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MINIATURE SOLDERING IRON

110-115 volts
No Transformer

Weighs 1 ounce
6½ inches long

$4.35 EACH IN LOTS OF 6
Tips extra

Precision . . .

the best low wattage soldering iron made . . . has sealed element to maintain constant temperature around 626°F.

- Ultra-flexible 3-wire cord . . . grounded . . . 50 megohms between element and tip protects components and operator.
- Bright "safety" yellow handle stands more than 1000°F . . . stays cool.
- Easy slide-on tips . . . stay hot under production speeds . . . made of tungsten-copper alloy; nickel or iron plated; diameters from 3/32" to 3/16"; spade or chisel ends.

Irons furnished less plugs: heavy-duty 2 or 3-pronged plugs available.

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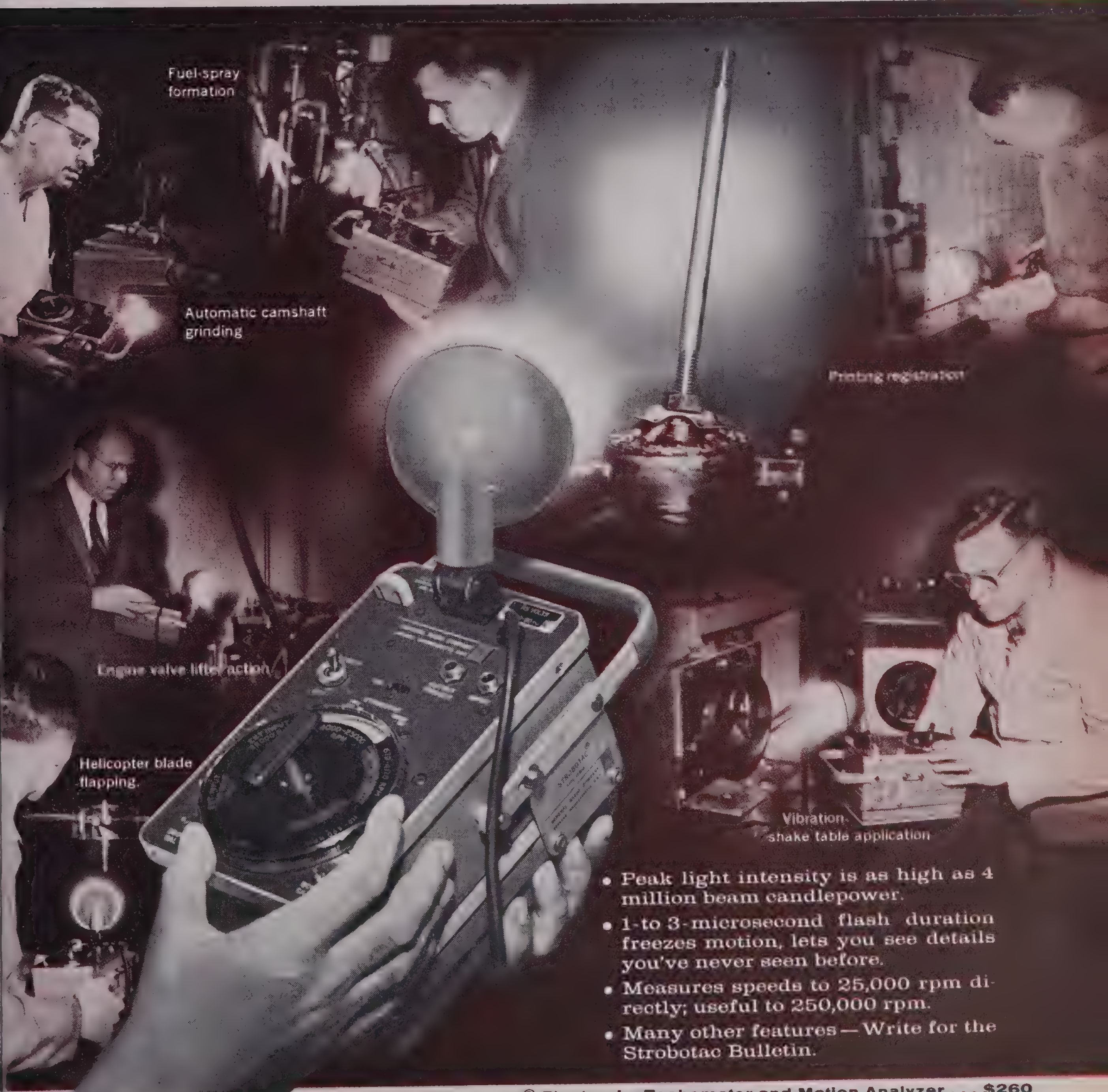
for Speed Measurement and Motion Analysis of these and many other Mechanical Actions



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- 1-to 3-microsecond flash duration freezes motion, lets you see details you've never seen before.
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- Many other features — Write for the Strobotac Bulletin.

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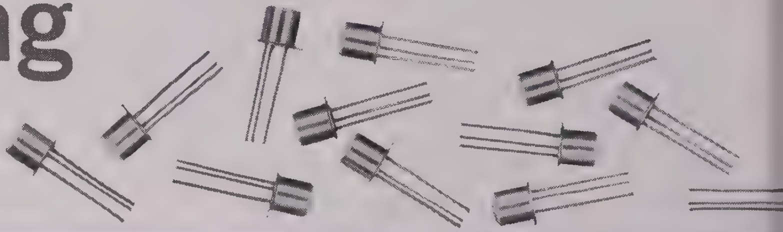
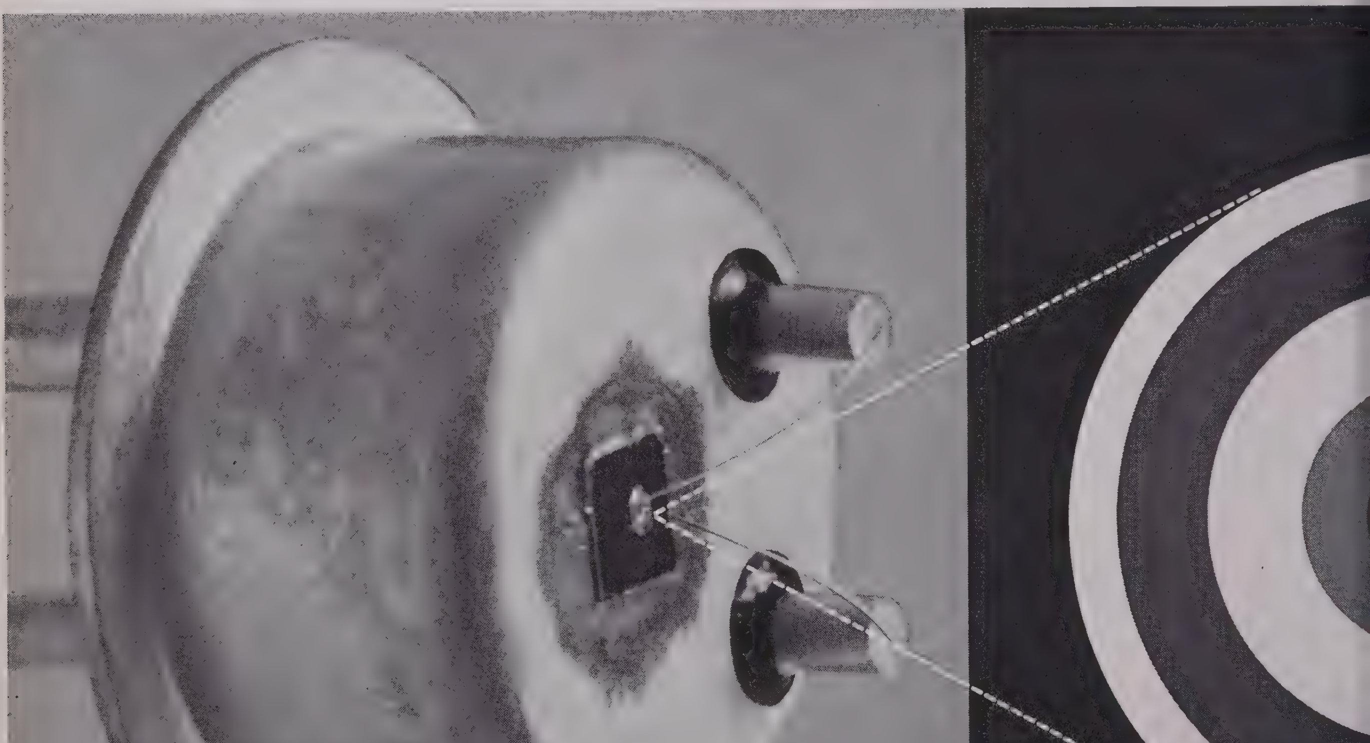
Introducing... concentric geometry

A significant improvement in NPN diffused silicon mesa fast-switching transistors





Hughes Semiconductor Division offers immediate delivery of a *whole family* of exceptionally fast-switching *NPN* silicon mesa transistors.

These devices incorporate a new design feature that increases both performance and reliability.

We call it concentric geometry—with a continuous surrounding base contact. It provides extremely low base spreading resistance r_b'. This results in a faster switch and a much improved amplifier.

This new design also greatly simplifies transistor construction assuring uniform quality and high reliability.

Hughes NPN silicon mesa transistors also provide other important advantages—controlled gain bands, low storage time, high f_t, low collector saturation voltage.

Here are some typical values for these high-performance transistors: 2N706 ... I_{CBO} = 20 mμA; 2N706A ... V_{CE} = 0.3V, t_s = 15 nsec.; 2N706B ... r_b' = 15 ohm, t_s = 15 nsec.; 2N707 ... $r_b'C_c$ = 60 psec, f_{max} = 400mc; 2N753 ... V_{CE} = 0.3V, t_s = 20 nsec.

To get complete information on these high performance NPN transistors—or Hughes extensive PNP line—contact your nearest Hughes Semiconductor Sales Office or Hughes Authorized Distributor. Or write Hughes Semiconductor Division, Marketing Department, Newport Beach, California. For export, write Hughes International, Culver City, California.

Creating a new world with Electronics

HUGHES

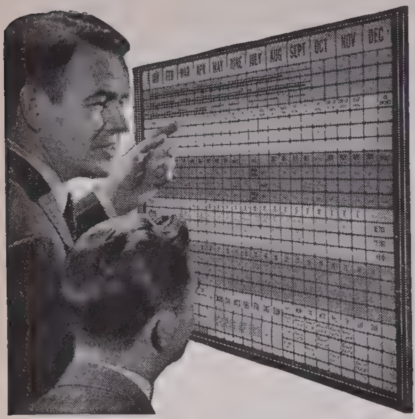
HUGHES AIRCRAFT COMPANY
SEMICONDUCTOR DIVISION

Type	Breakdown Voltages @—100μA			BV_{CER} I_C= 2mA R_{BE}= 10Ω (V)	h_{FE} I_C—10mA V_{CE}—1V		Min. f_t I_C= 10mA V_{CE}= 15V (mc)	Max. Switching Time (nsec)			Max. I_{CBO} @15V (μA)	Max. C_{ob} @5V (pf)	V_{CE} I_C= 10mA I_B= 1mA (V)	V_{BE} (sat) I_C=10mA I_B=1mA (V)		r_b'
	BV_{CBO} (V)	BV_{EBO} (V)	BV_{CEO} (V)		Min.	Max.		t_{on}	t_{off}	t_s						
2N706	25	3	—	20	20	—	200	—	—	60	0.5	6	0.6	—	0.9	—
2N706A	25	5	15	20	20	60	200	40	75	25	0.5	5	0.6	0.7	0.9	—
2N706B	25	5	15	20	20	60	200	40	75	25	0.5	5	0.4	0.7	0.9	50
2N753	25	5	15	20	40	120	200	40	75	35	0.5	5	0.6	0.7	0.9	—
2N707	56	4	—	25	9	—	—	—	—	—	5.0	10	0.6	—	0.9	—

Standard TO-18 Case; 1 Watt dissipation @ 25°C case temperature

Circle 104 on Inquiry Card

How To Get Things Done Better And Faster



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GRAPHIC SYSTEMS
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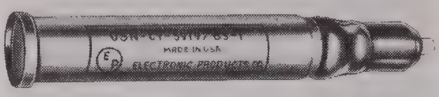
New Products

DETECTOR TUBES

Conform to Mil specs., and are for gamma and beta detection.

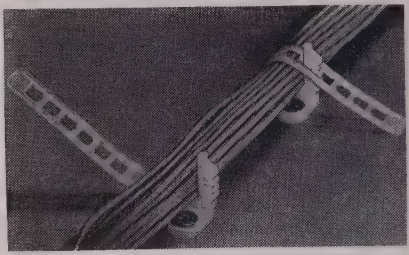


Model EP70G/5980 is a halogen-filled tube recommended for high level gamma detection. The Victoreen EP70M/5979 (pictured) approved under Mil-E-906A, is a mica end-window, halogen-filled detector for beta and gamma rays. It measures 6 x 1 in. It is available on special order with a 1.4-2.0 mg/cm² end-window and/or for 900 v. operation. RETMA 4-pin base can be furnished. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 303 on Inquiry Card

NYLON CLAMP

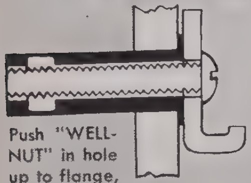
Clamp is for both temporary and permanent assembly.



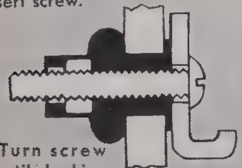
These nylon cable clamps require no tools for fast, easy clamping and hanging of bundles or single cables. Weckesser Tab-Loc® clamps are adjustable from ⅜ to ¾ in. dia. bundles. Easily opened for adjustment, removal or addition of wires, Tab-Loc clamps are reusable. Withstand vibration tests to 20G at 2000 CPS and 50 impact shock tests from 5G through 120G. Clamps are made of solid nylon. Weckesser Co., Inc., Dept. ES-2, 5701 Northwest Hwy., Chicago 46, Ill.

Circle 304 on Inquiry Card

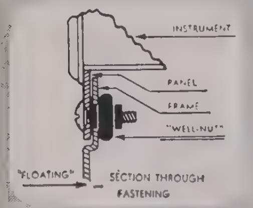
"WELL-NUT"



Push "WELL-NUT" in hole up to flange, place article in position, insert screw.



Turn screw until bushing bulges and seals hole.



Typical installation—mounting instrument in wall or panel.

the versatile blind fastener that

- dampens vibration
- muffles noises
- prevents leaks

The "WELL-NUT" is a flanged neoprene bushing with a brass nut bonded inside the narrow end. In making an assembly, the narrow end is inserted into a hole in the inner panel until the flange rests against the outer surface. The outer part of the assembly is placed against the flange with the holes concentric. A conventional screw is then thrust into the bushing and turned into the nut, drawing the latter against the inner surface. The tension on the nut causes the bushing to bulge laterally, tightly sealing the hole and the threads of the screw. Access to the inner surface of the assembly is not necessary. The "WELL-NUT" works equally well in hole or cavity. 13 standard sizes; special sizes available in quantity.

ROCKWELL PRODUCTS CORPORATION
146 Central Avenue, Dept. A, Newark 3, N. J. Tel.—MArket 3-7650

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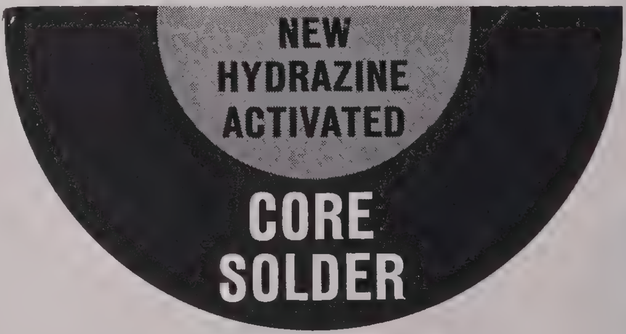

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Non-corrosive HYDRAZINE FLUX,* used industry-wide in liquid form, has now been incorporated into core solder. This fast, efficient flux vaporizes completely at soldering temperatures. It leaves no residue which would support fungus growth. Will not corrode.

In H-32 core solder for the first time, HYDRAZINE FLUX offers more advantages than ever. When flux is normally applied, far more than is actually needed is used. Now, the exact ratio of flux to solder provides for proper wetting. Thereafter the flux decomposes and is eliminated. Cleaning and production time are saved.

TEST HYDRAZINE FLUX AND CORE SOLDER in your own plant. Write for samples of either H-Series Fluxes or H-32 core-solder form and technical literature.

*U.S. Patent No. 2,612,459

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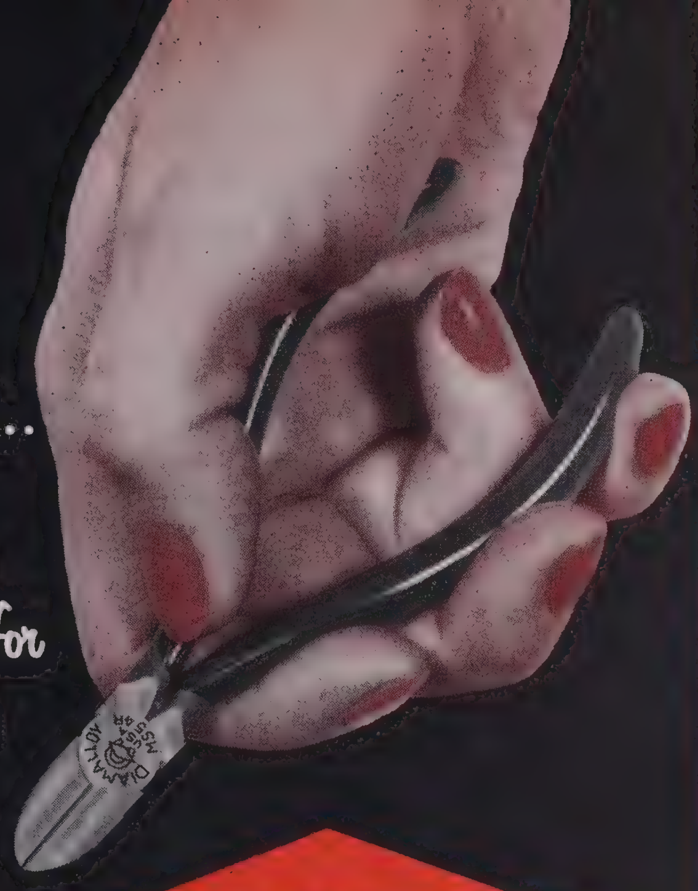

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With or without coil spring or plastic handles.

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Long Nose Plier
CN54

Transverse
End Cutting Plier
EC54

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SN54

Long Nose Plier
LN54

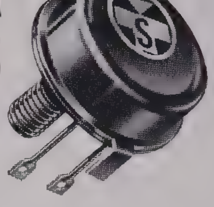
Diagonal
Cutting Plier
MS54

Wire
Stripping Plier
ST55

Long Nose
Special Wire Cutter
LC56

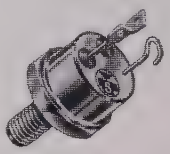
2N

2N1015
2N1015A
2N1015B
2N1016
2N1016A
2N1016B



150 Watt

2N1212
2N1208
2N1616
2N1617
2N1618
2N1616A
2N1617A
2N1618A
2N1724



85 Watt

WESCON Booth 1224

SILICON TRANSISTOR CORP. ADDS 2 NEW SERIES.

THE COMPLETE LINE OF HIGH POWER SILICON TRANSISTORS

The series...

2N1015	**2N1016**
2N1015A	**2N1016A**
2N1015B	**2N1016B**

are 150 watt single-end stud types. With collector-emitter voltages of 100 volts. Saturation resistance of 0.5 ohms. Minimum beta of 10 at 5 amps.

The series

2N1212	**2N1616**
2N1208	**2N1617**
	2N1618

are double-ended 11/16″ 85 watt hex stud types.

And...

	2N1616A
2N1724	**2N1617A**
	2N1618A

are the most popular series in this package, with dramatic improvements from STC.

BVCEO of 80 volts. Saturation resistance of 0.5 ohms. Minimum beta of 10 at 5 amps.

Both STC series have the lowest leakage currents in the industry...high temperature stability...low thermal resistance and reliability at full power ratings. Write for Catalog listing complete line of STC's high and intermediate power silicon transistors and silicon diodes.

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CARLE PLACE, LONG ISLAND, NEW YORK Pioneer 2-4100

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Waltham — TW 3-7020
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Princeton — WA 1-2150
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Arrow Electronics, Inc.
Mineola, L. I. — PI 6-8686
Progress Electronics
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Buffalo — TT 3-5000
Sun Radio & Electronics Co., Inc.
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Valley Industrial Electronics, Inc.
Utica — RA 4-5168
IN PENNSYLVANIA:
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Electra Distributing Co.
Nashville — AL 5-8444
IN TEXAS:
All State Electronics, Inc.
Dallas — RI 1-1295
Lenert Company
Houston — CA 4-2663

News of Mfrs' Representatives

Barnes Engineering Co., Stamford, Conn., has appointed three new sales representatives: **Martin P. Andrews, Inc.**, Fayetteville, N. Y., to cover New York State north of Westchester County; **Dannemiller-Smith, Inc.**, Houston, Tex., for Texas, Oklahoma, Arkansas and Louisiana; and **F. Y. Gates Co.**, Salt Lake City, Utah, to cover Idaho, Wyoming, Nevada, Utah, Colorado and New Mexico.

Kierulff Electronics, Inc., Los Angeles and San Diego, Calif., has been named representatives for the West Coast area by Silicon Transistor Corp., Carle Place, N. Y.

Diotran Pacific, Palo Alto, Calif., has announced the appointment of two representatives: **Heim and Scheer**, Hollywood, Calif., to cover Southern California and Arizona; and **McKnight Co.**, Menlo Park, Calif., to cover Northern California.

Lee Sales Co., Dayton, Ohio, has been named representatives for Quan-Tech Laboratories, Inc., Boonton, N. J., to cover the area of Ohio, Michigan, Kentucky, West Virginia and Western Pennsylvania.

American Electronics, Inc., Precision Power Div., Fullerton, Calif., announced the appointment of **RMC Associates**, New York, N. Y., as representatives for the greater Metropolitan New York City and Northern New Jersey areas.

RFW Engineering Co., Clearwater, Fla., named representatives for Ace Electronics Associates, Inc., Somerville, Mass., to cover the state of Florida.

Cryogenics, Inc., Stafford, Va., announces the appointment of **Applied Technology, Inc.**, Manchester, Mass., as representatives in Massachusetts, Connecticut, Rhode Island, New Hampshire, Maine and Vermont.

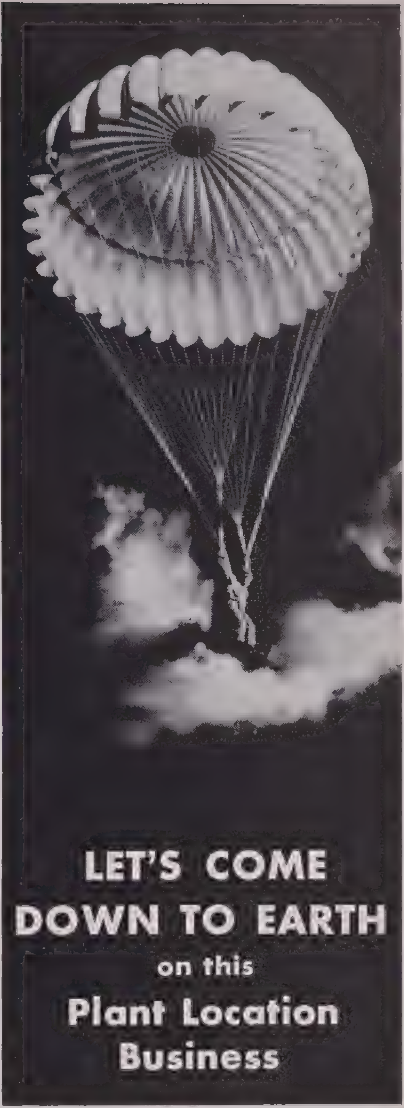
Cain & Co., appointed representative for Trak Electronics Co., Inc., Wilton, Conn., to cover the midwestern states.

The Birtcher Corp.'s Industrial Div., Monterey Park, Calif., announces the appointment of **Busacker Electronic Equipment Co., Inc.**, Houston, Tex., as representatives in the state of Texas.

Neely Enterprises, No. Hollywood, Calif., named representatives by Ingersoll Products, Div. of Borg-Warner Corp., to cover California, Nevada, Arizona and New Mexico.

Macallen Co., Inc., Newmarket, N. H., announces the appointment of **Andrew Gilchrist, Ltd.**, St. Laurent, Quebec, as representatives for Canada.

(*Continued on page* 180)



No area can be all things to *all* industries. But we've got down-to-earth facts that prove the Toledo-Northwestern Ohio area is right for Electronics Industries. These facts are reported in a study of the area by Fantus Research, Inc., one of the nation's foremost industrial location services. If you would like to evaluate this information in terms of your plant location plans, write R. E. Johnson, Manager, Industrial Development Department, The Toledo Edison Company, Toledo 1, O.

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an investor-owned electric light and power company serving Northwestern Ohio

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ÉLECTRONIQUES

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phone: PASsy 01.16

Circle 76 on Inquiry Card

News of Mfrs' Representatives

Cambridge Thermionic Corp., Cambridge, Mass., announces that **R. C. Whitmore & Associates**, Chicago, Ill., is expanding its representation to the states of Indiana and Kentucky.

R. C. Merchant & Co., Inc., Detroit, Mich., appointed sales representatives for Sola Electric Co., Div. of Basic Products Corp., Elk Grove Village, Ill., to cover the state of Michigan.

George Spence, Inc., Minneapolis, Minn., has been appointed representative of the Corning Electronic Components Dept., Corning Glass Works, Corning, N. Y.

Elgin Advance Relays, Electronics Div., Elgin National Watch Co., Burbank, Calif., has appointed **Syd Wimpie Associates**, Port Chester, N. Y., sales representative to cover New York City (urban and metropolitan) and Newark, N. J.

Roger C. Damm appointed Southwest District sales representative for Motorola Semiconductor Products, Inc., Phoenix, Ariz., to cover the areas of Texas, Oklahoma, Arkansas, Louisiana, and Mississippi.

Tape Reader Div., Photocircuits Corp., Glen Cove, N. Y., announces the appointment of **Brogan Associates**, Mineola, N. Y., as representatives to cover New England, New York State and Northern New Jersey areas.

W. T. Blackburn Associates, Dallas, Tex., named representatives by PCA Electronics, Inc., Sepulveda, Calif., to cover Arkansas, Louisiana, Mississippi, Oklahoma and Texas.

Clarostat Mfg. Co., Inc., Dover, N. H., announces the appointment of **EDCOM, Inc.**, Newtonville, Mass., as representatives covering all the New England states.

Waveline, Inc., Caldwell, N. J., has appointed as representatives, **Technical Sales Co.**, Wichita, Kans., to cover the Kansas area and **Technical Sales Co.**, Kansas City, Mo., to cover the Missouri area.

Quan-Tech Laboratories, Inc., Boonton, N. J., has appointed **Lee Sales Co.**, Dayton, Ohio, representatives to cover Ohio, Michigan, Kentucky, West Virginia and Western Pennsylvania.

Haveg Industries, Inc., Wilmington, Del., announces the appointment of **Asbestos Corp. of America**, Garwood, N. J., as their Eastern Seaboard representative.

Linn O. Morrow & Son named representatives for Curtiss-Wright Corp., Princeton Div., Princeton, N. J.

Circle 113 on Inquiry Card →

Philco Solid-State X-Band Switches can

MODERNIZE THESE 8 MICROWAVE CONCEPTS

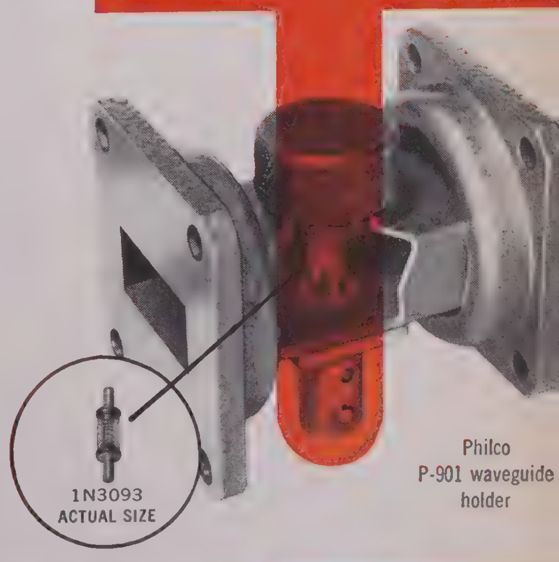
- Electronically Steerable Antennae
- Microwave Channel Switching
- Microwave Modulators
- Voltage Controlled Microwave Attenuators
- Microwave Pulse Shapers
- Microwave Limiters
- Microwave Clippers
- Direct Switching of Transmitter and Receiver Power

Solid-state design is an apparent trend in microwave equipment. The inherent advantages are solid-state reliability, smaller size, lighter weight, lower power requirements, less auxiliary components . . . and Philco X-Band Germanium switching crystals help make this trend possible.

Philco types 1N3093, 1N3481, and 1N3482 have several unique features. They exhibit total switching times as short as 1 nanosecond. These three types can be intermixed in cascade to provide extremely high isolation values . . . without unduly sacrificing insertion loss or power handling capability. They serve as frequency-independent switches between DC and 1 Gc. Virtually *any* application requiring rapid and predictable control or modification of microwave power flow can utilize these diode switches.

Though ratings shown on this page are based on mounting in a commercially available Philco P-901 waveguide holder, Philco X-Band switching crystals also are suited to coaxial transmission designs.

ABSOLUTE MAXIMUM RATINGS	1N3481	1N3093	1N3482
Storage Temperature....	−65 to +90°C	−65 to +90°C	−65 to +90°C
Forward Current........	60 ma	85 ma	100 ma
Reverse Current........	5 ma	10 ma	10 ma
Peak Microwave Incident Power Level..........	10 mw	500 mw	1.25 w
ELECTRICAL CHARACTERISTICS			
Test Conditions (T=25°C)			
Test Frequency.........	9000 mc	9000 mc	9000 mc
Power Level............	1 mw	500 mw	1.25 w
Test Holder............	Philco P-901	Philco P-901	Philco P-901
Dynamic Characteristics			
Insertion Loss..........	(I = +50 ma) Typ. Max. 0.75 1.0db	(I = +75 ma) Typ. Max. 1.6 1.8db	(I = +100 ma) Typ. Max. 2.0 2.3db
Isolation..............	(V = −0.5v) Min Typ. 18 21db	(V = −11v) Min. Typ. 18 21db	(V = −11v) Min. Typ. 18 20db


1N3093 ACTUAL SIZE

Philco P-901 waveguide holder

For complete data and application assistance, write Dept. EI861M. **SPECIAL PRODUCTS OPERATION**

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ULTRA COMPACT AUDIO UNITS

TRANSFORMERS AND REACTORS

UTC "A" SERIES, Ultra Compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. They are designed for both transistor and tube applications. High fidelity is obtainable in all individual units, the frequency response being ± 2 db from 20 to 20,000 cycles, except where noted. Hermetic equivalents, "H" series, are available manufactured to MIL-T-27A. All units except those carrying DC in Primary employ a true hum balancing coil structure, which combined with a high conductivity outer case, effects good inductive shielding. The die-cast case provides for top or bottom mounting. These units are adaptable for use in printed circuits.

UNITED TRANSFORMER CORPORATION
150 Varick Street, New York 13, N. Y.
PACIFIC MFG. DIVISION
4008 W. Jefferson Blvd., Los Angeles 16, Calif.
EXPORT DIVISION:
13 East 40th Street, New York 16, N. Y.

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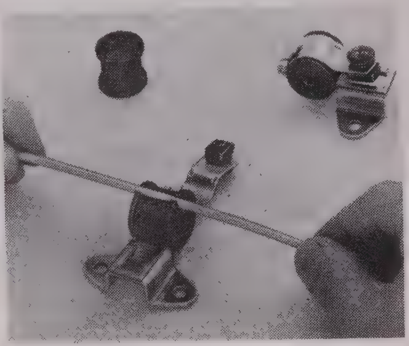
Circle 114 on Inquiry Card

New Products

QUICK-DISCONNECT CLAMP

Tube and wire diameters as small as 1/8 in. can now be harnessed.

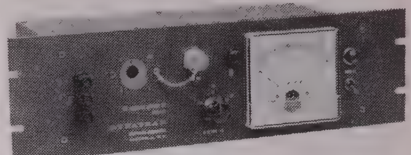


Flip-Loc® Clamps have molded insert that insulates and cushions tube or wire and permits fast access by means of the hinge and quick detach key-nut fixture. Maintenance and replacement are cut by fast disassembly without removing clamp from mounting. Resilient insert offers complete 360° grip preventing pinching or chafing. Insert available in neoprene, or aromatic fuel resistant material. TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

Circle 305 on Inquiry Card

GAIN TEST SET

Tests mesa, drift and surface barrier transistors.



Model 1828, 20 MC Gain Test Set provides direct readings of the 20 MC grounded emitter current gain (h_{fe}) on a large easy-to-read panel meter. The gain ranges are 0-3, 0-10 and 0-30. Has a built-in socket for both long and short lead transistors. Comes in 2 versions with and without built-in regulated bias supplies for both npn and pnp transistors. Dynatran Electronics Corp., 178 Herricks Rd., Mineola, N. Y.

Circle 306 on Inquiry Card

SONOTONE GRANTED FULL PARTICIPATION IN U. S. ARMY SIGNAL CORPS R.I.Q.A.P. PROGRAM

Sonotone's methods of production and quality control on electronic tubes are so rigid, the U.S. Army Signal Corps has officially reduced inspection of the company's full line of military tubes. This company is the first electronic tube manufacturer to qualify for complete R.I.Q.A.P. participation utilizing the concept of "paired attributes-verification" for acceptance by government inspection. All Sonotone tubes—military and industrial—conform to the same high standards. Over 200 to choose from—including many hard-to-get European types. Specify Sonotone when you want to be sure of quality.

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ELECTRONIC APPLICATIONS DIVISION
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diodes and rectifying cells from 50 ma through 250 amps at 25-1000 volts per junction

Incomparable breadth of line . . . International Rectifier produces reliable diodes and rectifying cells rated from 50 ma through 250 amps at 25-1000 volts per junction . . . produces series/parallel combinations through 100,000 amps and 320,000 volts. (Higher ratings available for special applications).

SILICON STUD MOUNTED POWER RECTIFIER CELLS

1.8 AMP HERMETICALLY SEALED TYPES – **100 to 600 PRV rated**
6 AND 12 AMP. HERMETICALLY SEALED TYPES – **50 to 500 PRV rated**
25 TO 45 AMP. HERMETICALLY SEALED TYPES – **50 to 500 PRV rated**
45 TO 150 AMP. HERMETICALLY SEALED TYPES – **50 to 800 PRV rated**
70 TO 250 AMP. HERMETICALLY SEALED TYPES – **50 to 500 PRV rated**
25 TO 35 AMP. "QUAD-SEALED" ECONOMY TYPES – **50 to 500 PRV rated**

SILICON GENERAL PURPOSE RECTIFIER CELLS

SUBMINIATURE GLASS DIODES – **High Conductance and General Purpose Types**
SUBMINIATURE "TRI-SEALED" ECONOMY 4M SERIES – **400 ma rated, 225 to 600 PRV**
MINIATURE "TRI-SEALED" ECONOMY 5A SERIES – **500 ma rated, 200 to 600 PRV**
DIFFUSED JUNCTION "PLUG-IN" 5M SERIES – **500 ma rated, 200 to 600 PRV**
"TRI-SEALED" ECONOMY 2E4, 5E4, 5E5, 5E6 SERIES – **200 to 500 ma rated, 400 to 600 PRV**
HERMETICALLY SEALED MINIATURE AXIAL LEAD SERIES – **300 to 500 ma, 50 to 500 PRV**
JAN-APPROVED MILITARY SERIES – **1N253, 1N254, 1N255,1N538, 1N540, 1N547**
HERMETICALLY SEALED AXIAL LEAD SERIES – **300 to 800 ma, 50 to 600 PRV**
HERMETICALLY SEALED STUD MOUNTED SERIES – **800 ma rated, 50 to 600 PRV**

SILICON VOLTAGE REGULATOR DIODES AND REFERENCE ELEMENTS

SUBMINIATURE GLASS ZENER DIODES – **250 milliwatt rated**
HERMETICALLY SEALED AVIAL LEAD STYLE M SERIES – **750 milliwatt rated**
HERMETICALLY SEALED AXIAL LEAD STYLE S SERIES – **1 watt rated**
HERMETICALLY SEALED STUD MOUNTED STYLE T SERIES – **3.5 watt rated**
HERMETICALLY SEALED STUD MOUNTED STYLE T SERIES – **10 watt rated**
1N430 VOLTAGE REFERENCE ELEMENTS – **8.4 volts (average) voltage reference**
1N1530 MINIATURE VOLTAGE REFERENCE ELEMENTS – **8.4 volts (average) voltage reference**
HIGH STABILITY VOLTAGE REFERENCE PACKS – **8.4 and 16.8 volts dc output**

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MINIATURE SELENIUM RECTIFIER CELLS – **250 μa to 28 ma; 48 to 384 PRV**
SELENIUM CONTACT PROTECTORS, AC AND DC TYPES – **Diode, cartridge & hermetically sealed types**

Write for short form catalog
escribing comprehensive IR line
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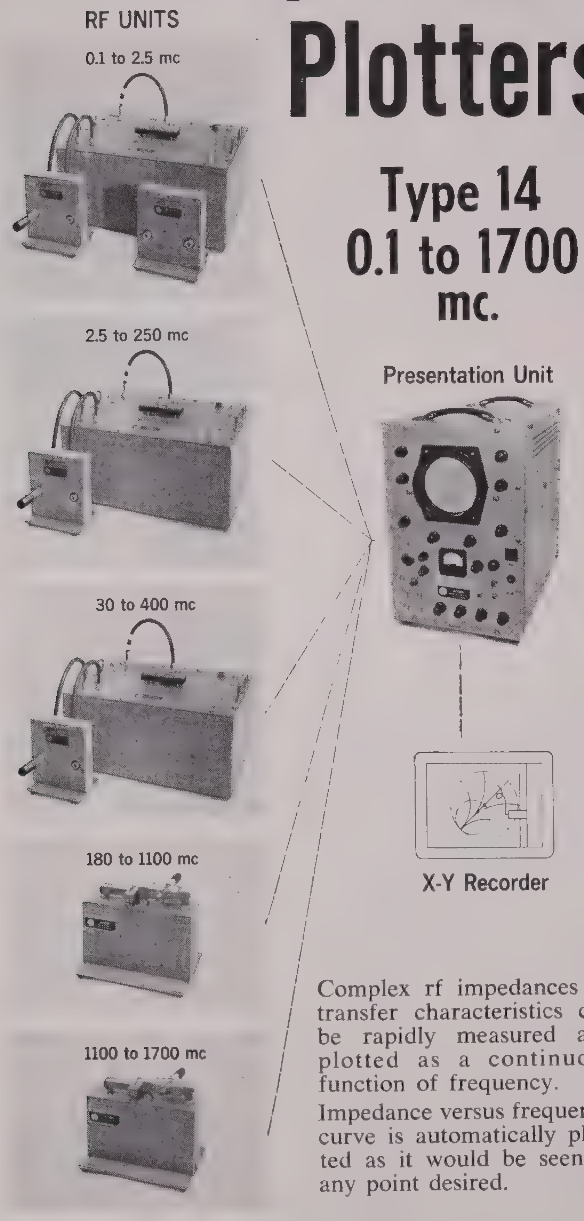
AMCI ®

Automatic Impedance Plotters

Type 14 0.1 to 1700 mc.



Complex rf impedances or transfer characteristics can be rapidly measured and plotted as a continuous function of frequency.

Impedance versus frequency curve is automatically plotted as it would be seen at any point desired.

OTHER FEATURES:

- Entirely self-contained, except for the use of an external oscillator.
- Instantaneous choice of three different Smith-Charts: infinity to 1, 2 to 1, and 1.2 to 1.
- Quick investigation of impedance and transfer characteristics even when several independent variables exist.
- Can be used to measure impedances, admittances, and reflection coefficients in systems under power.

Write for complete details and catalog.

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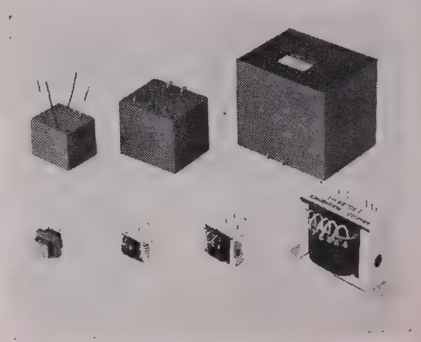
New Products

SMOOTHING CHOKES

Hermetically sealed units for aircraft and missile use.

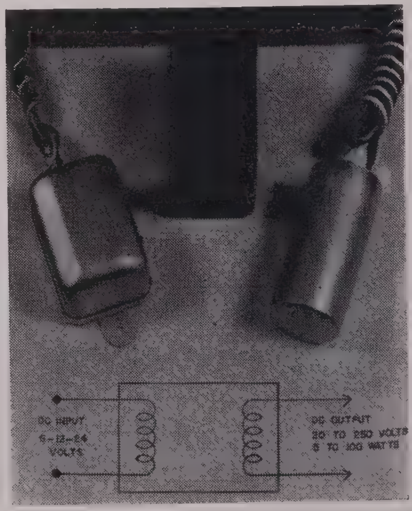


Fully encapsulated and built to withstand environment of Mil-E-5272 and Mil-T-27A. Chokes feature integrally cast mounting holes for easy assembly to chassis or printed circuit boards. Electrical terminations are supplied extending from the top, bottom, or side. Inductances range from 0.2 mh to 5100 h, at dc currents from 6 ma to 25 a. Dimensions from 1.12 x 0.91 x 0.87 in. to 1.77 x 1.46 x 1.49 in. Arnold Magnetics Corp., 6050 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 315 on Inquiry Card

POWER CONVERTERS

Commercial-industrial units measure 1½ x 1½ x 3 in.



For use in entertainment, communications and portable instrumentation applications. Models are available with 10 to 100 ratings for 6 or 12 vdc operation. Converters are fully transistorized, complete with rectifier and filter system. Also available, are models to meet Military requirements. James Electronics Inc., 4050 N. Rockwell St., Chicago 18, Ill.

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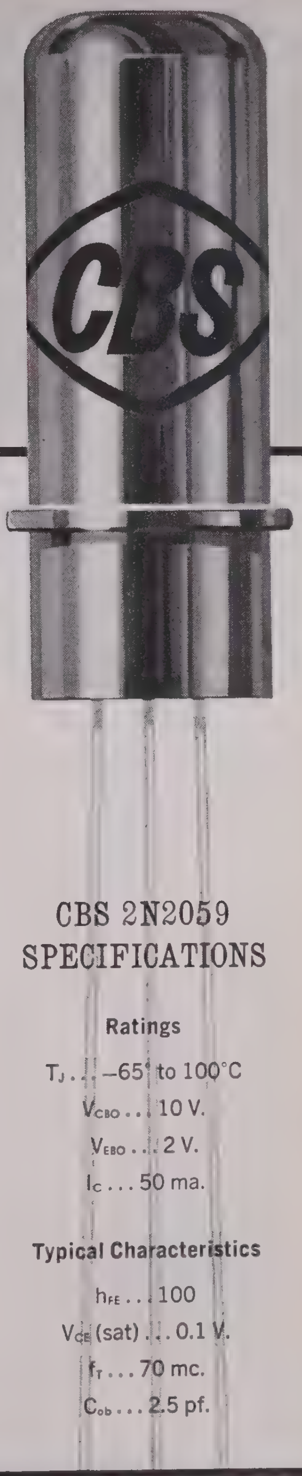
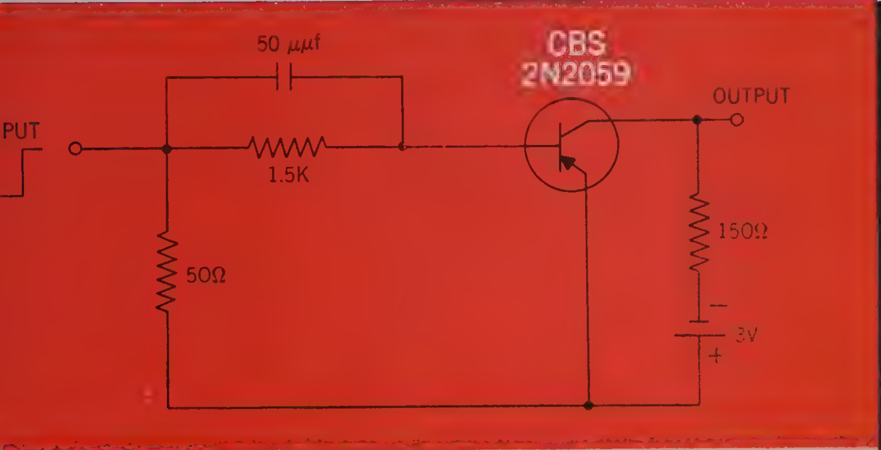
Circle 118 on Inquiry Card →

Semiconductors for Computer Circuitry

High-Speed Switching at HALF THE COST with New CBS 2N2059 Economy MADT* Transistors





SWITCHING TIME is 22 nanoseconds in this high-speed circuit.

High-speed switching . . . lower saturation voltage and resistance . . . high current gain . . . lower collector capacitance . . . more uniform performance . . . all the advantages of automatically produced Micro Alloy Diffused-base Transistors are available at half the cost of other commercially available high-speed transistors in the new CBS MADT 2N2059.

Check the high-speed switching circuit above. It is easily cascaded and permits a reduction in the size and cost of power supply because it operates at only three volts. The CBS 2N2059 is a particularly economical choice for logic, pulse generating and shaping circuits as well as high-current pulse amplifiers.

Call or write your nearest CBS Electronics sales office or Manufacturer's Warehousing Distributor for data, price and delivery information . . . and order your engineering samples today.

*Micro Alloy Diffused-base Transistor, Trade-mark, Philco Corp.

CBS 2N2059 SPECIFICATIONS

Ratings

T_J . . . –65 to 100°C
V_{CBO} . . . 10 V.
V_{EBO} . . . 2 V.
I_C . . . 50 ma.

Typical Characteristics

h_{FE} . . . 100
V_{CE} (sat) . . . 0.1 V.
f_T . . . 70 mc.
C_{ob} . . . 2.5 pf.

CBS ELECTRONICS

Lowell, Massachusetts
A Division of Columbia Broadcasting System, Inc.

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→See us at Wescon! CBS Booths 2903 & 2905/Ross

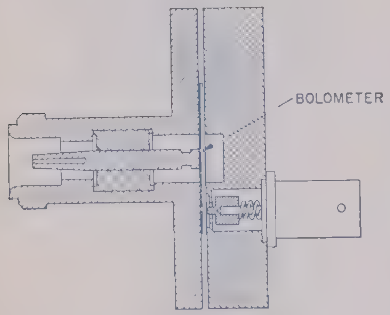
PRD *previews / reviews / design notes*

Bolometers, Barretters, and Thermistors

We have often been asked, "What is the difference between a bolometer, a barretter, and a thermistor?" At PRD the following is generally accepted: *Bolometer* is a general term which describes a temperature-sensitive element whose resistance changes as it dissipates microwave power. Bolometers include (a) thin short lengths of Wollaston wire, (b) evaporated metallic film, (c) small beads of semiconductors. The wire and film types are called "bolometers" or "barretters" and have a positive temperature coefficient. The semiconductor is called a "thermistor" and has a negative temperature coefficient.

Power Measurement Equipment

The bolometer, plus appropriate mount, provides us with an accurate, dependable means of measuring microwave power. In itself, of course, the bolometer is a temperature-sensitive resistor, and gives no indicator reading. The most commonly used instrument for direct reading of microwave power is the self-balancing bridge. The PRD 650-B Universal Power Bridge can accommodate bolometers, barretters, or thermistors and reads power directly to 100 milliwatts.



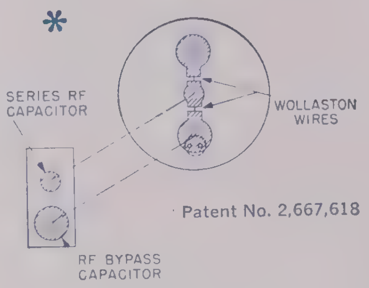
BOLOMETER MOUNT

PRD 631-C

Design Details

The drawing above is the PRD 627-A Broadband Coaxial Bolometer and Thermistor Mount which houses the PRD 631-C (wire type), PRD 631-D (film type), and PRD 631-G (thermistor). The two general types of bolometers manufactured by PRD are Wollaston wire and evaporated metallic film applied to thin mica discs. The PRD 631-G Thermistor uses two semiconductor bead elements and has excellent stability characteristics.

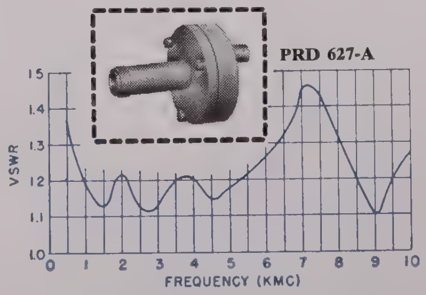
Each bolometer has a nominal operating resistance of 200 ohms when biased. For low power (1 mw max.), the PRD 631-C uses short lengths of Wollaston wire which when deplated cannot be seen by the naked eye but must be delicately constructed under powerful microscopes. The metallic film units (PRD 631-D) are high power devices and can dissipate up to 100 mw.



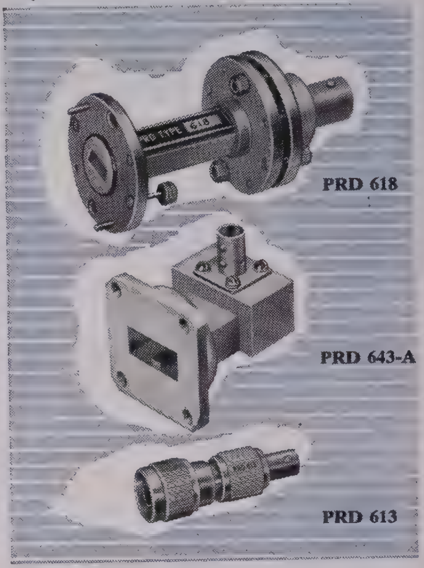
BOLOMETER ELEMENT

Mounts

PRD bolometer mounts, such as the PRD 627-A, require no tuning, operate over a frequency range of 500 to 10,000 megacycles/sec, and are designed to insure high efficiency. The mount provides a low VSWR over the entire band and allows for easy replacement of bolometer elements without retuning. A typical VSWR curve is shown.



PRD produces a variety of mounts and bolometers. These include coaxial, waveguide, tunable, and broadband. Shown are, from top to bottom, a Waveguide Bolometer Mount (PRD 618) which operates from 26.5 to 40 KMC/S, a Waveguide Thermistor Mount (PRD 643-A) for 8.2 to 12.4 KMC/S, and a Coaxial Crystal and Bolometer Mount (PRD 613) for 1 to 12 KMC/S.



Precision in Production

PRD offers as standard catalog items some 34 different mounts and seven types of bolometers and thermistors. Our assembly line turns out several hundred bolometers alone in a week, all of which undergo rigorous stability and humidity tests after construction. PRD also produces, of course, all necessary associated equipment for power measurement. For more theoretical information, write for PRD Report Vol. 1, No. 4, "Microwave Power Measurements" or contact our Applications Engineering Department.

We have many interesting openings for engineers...contact Mr. John R. Zabka

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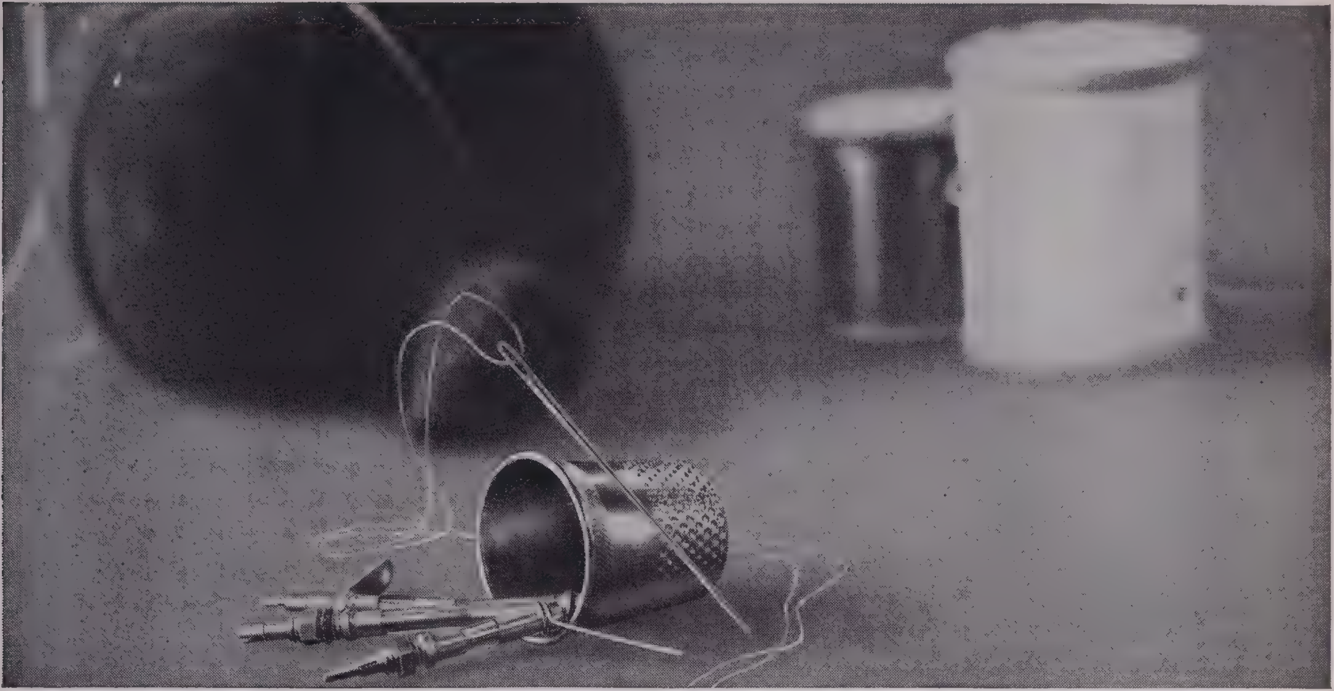

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- Low inductance for high frequency use.
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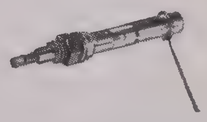
- 500 V. DC working voltage.
- 10^6 megohms insulation resistance.
- Q factor of 500 (measured as per JFD #5178).
- 0.5 inch ounce tuning torque.

Model*	Capacitance Range pf Measured Per JFD #5177 Min.	Max.	D.C. Working Volts	Dielectric Strength Measured For 5 Seconds at 50% R.H. at Max. Rated Cap.	Insulation Resistance Measured After One Minute at 500V. D.C. and 50% R.H.	Q Factor Measured Per JFD #5178	Unit Weight Grams	Dimen.** Max. ±1/32 K
PT901	0.5	2.0	500	1000	10^6 Megohms	500	0.62	⅜
PT902	0.5	3.0	500	1000	10^6 Megohms	500	0.64	½
PT903	0.5	5.0	500	1000	10^6 Megohms	500	0.79	¾
PT904	0.5	7.0	500	1000	10^6 Megohms	500	0.94	1

*These units are also available in the same capacitance values for printed circuit boards in models PT911, PT912, PT913 and PT914.

**Length front of panel.



(shows actual size) Model PT902

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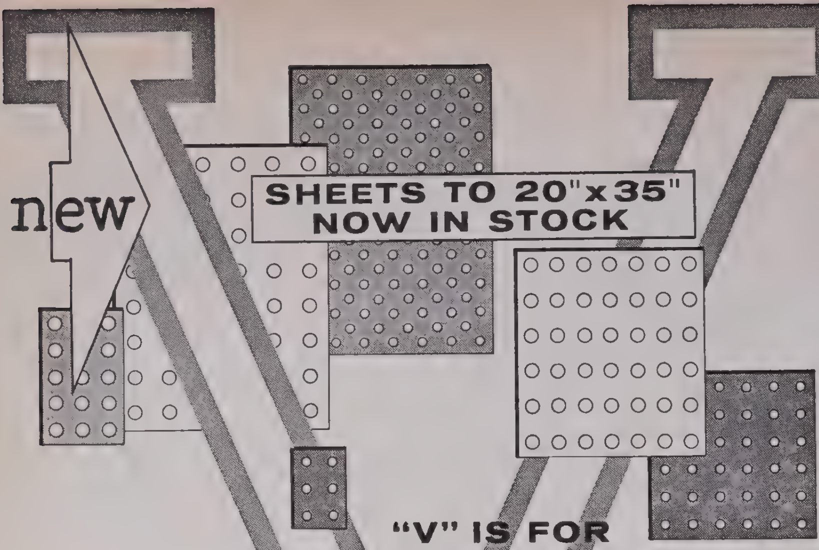

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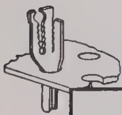

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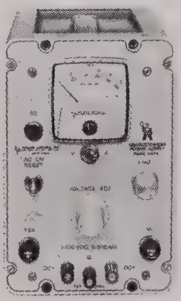

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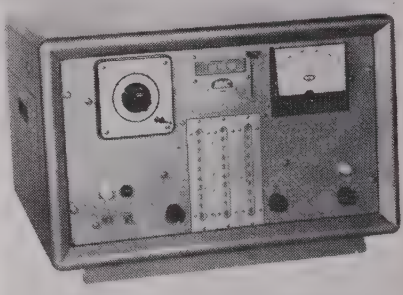

Model DS-1AP is for precision counting in the clinical, industrial and nuclear research fields. It is capable of registering 1 million/min., with counting periods of up to 55 min. preset in the automatic timer. The instrument monitors itself by an ambiguous indication in the strip for any counting error due to tube or component failure. Dimensions: 22 x 12 x 15 in. Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.

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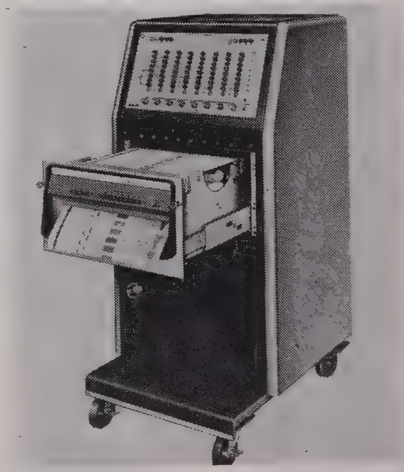
Features position feedback, forced fluid writing and ½% accuracy.



This 8-channel direct writing system, Recorder Mark 200, produces chart records of high accuracy and clarity. For use with analog computers, but equally suitable for general multichannel recording. Features include static and dynamic accuracy of ½%, complete absence of overshots, error-free rectilinear presentation, and a uniform nominal trace-width of 0.010 at all writing velocities. Brush Instruments, div. of Clevite Corp., 37th & Perkins, Cleveland 14, Ohio.

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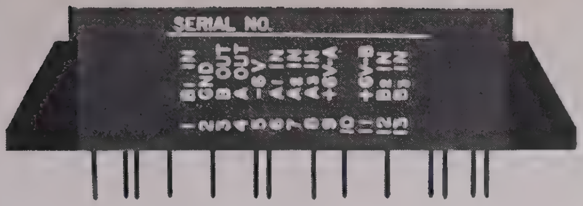

In less time than it takes light to cross this room, a new product, **DELCO'S NEW** high speed **10 MC** silicon modules, could: (1) correct the course of a missile in flight; (2) make it possible for sonar pickups to track and compute the position of targets with microsecond accuracy; and (3) handle any number of other airborne guidance and control functions that previous modules—due to low speed or environmental or performance limitations—could not handle. Delco Radio's 10mc modules, with a maximum gate-switch speed of 40 nanoseconds, convert data 100 times faster—even under the most extreme environmental conditions.

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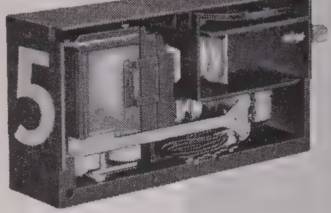

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Hallicrafters Unveils New Line of Equipment

Hallicrafters Co., Chicago, is increasing its staff and facilities to improve its capability in the military electronics area.

A prime supplier in the Electronic Countermeasures field, to the Air Force, Hallicrafters is expanding its field of interest to a wide range of measuring equipment and data transmission gear.

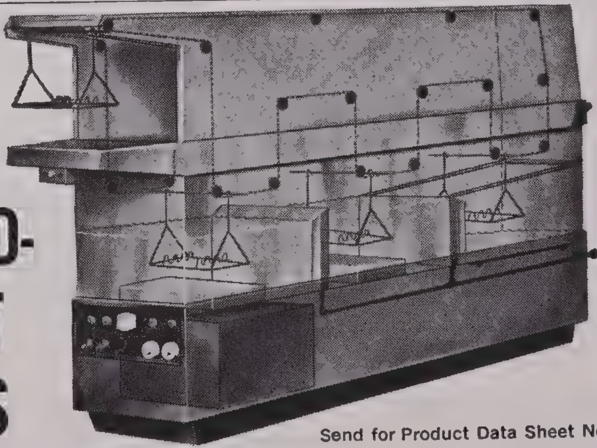
At a seminar conducted at its main office in Chicago, Hallicrafters described a number of new capabilities in antenna design, traveling wave tube applications, ground support equipment and military communications.

Among the new pieces of equipment was a microwave pulse generator which produces nano-second pulses at gigacycle frequencies from conventional radio frequency signal generators. The generator, MPG-3, can also serve as a self-contained wideband traveling-wave-tube amplifier or as a serrodyned amplifier for frequency translation.

Hallicrafters also unveiled an incremental microwave power spectrum analyzer for automatic plotting and continuous display of

(*Continued on page* 196)

CLEAN PRINTED-CIRCUIT BOARDS AUTOMATICALLY



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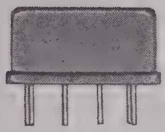

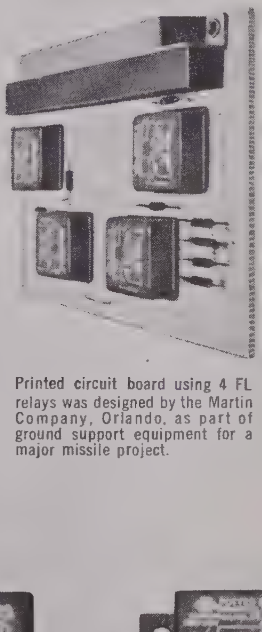

Printed circuit board using 4 FL relays was designed by the Martin Company, Orlando, as part of ground support equipment for a major missile project.

This DPDT, permanent magnet, latching relay is superior on these counts: (1) shorter height for maximum compactness between stacked circuit boards; (2) greater sensitivity (80 milliwatts); (3) better vibration resistance (30 g to 2000 cps); (4) better shock resistance (100 g).

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Call your nearest P&B representative today for complete information about the whole P&B family of microminiature relays.

FL SERIES SPECIFICATIONS

Contact Arrangement: DPDT

Shock: 100 g for 11 milliseconds with no contact openings.

Vibration: .195; max. excursions, 10 to 55 cps. 30 g from 55 to 2000 cps. No contact openings.

Linear Acceleration: 400 g minimum with no contact openings.

Pull-In: 150 milliwatts, approx. (standard) at 25°C. coil temperature.

80 milliwatts, approx. (sensitive) at 25°C. coil temperature

Operate Time: 3 milliseconds max. at nominal voltage at 25°C. coil temperature

Dimensions: .485" high, 1.100" long, .925" wide

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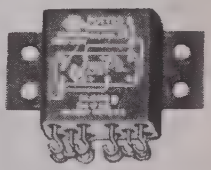

Terminals spaced on .200" grids are available on all P&B microminiature relays. These carry a "G" suffix (SCG and SLG) and are .890" high, .800" wide, .400" deep, max.

These 3 relays are shown slightly reduced in size.

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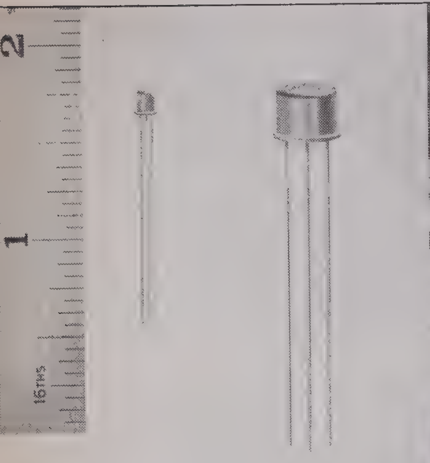

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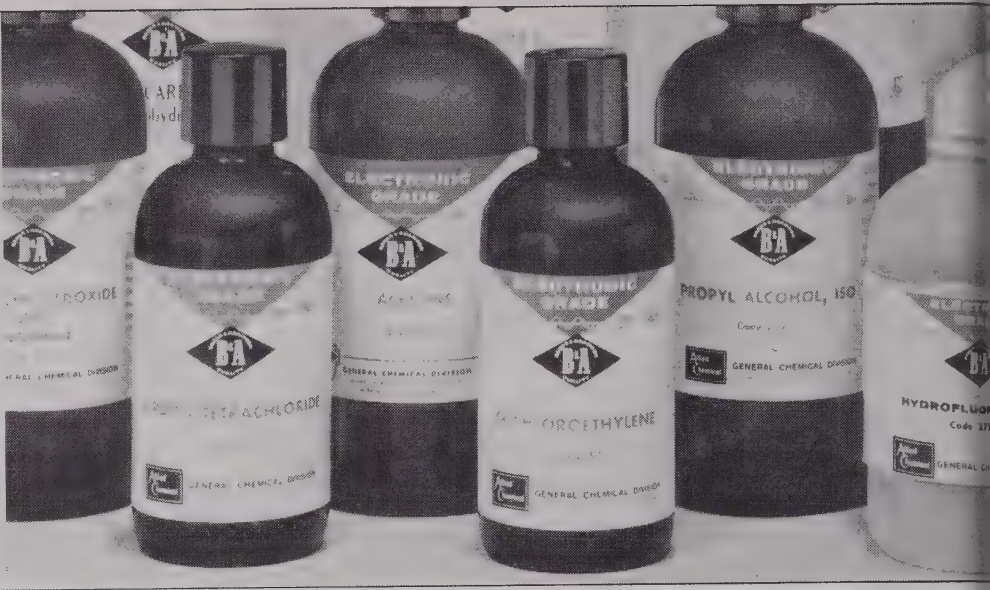

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Hallicrafters' Equipment

(Continued)

power-vs.-frequency characteristics for voltage-tuned oscillators and broad band RF amplifiers. Using sampling techniques, this instrument provides a continuous display of microwave signal power distribution with an accuracy formerly obtainable only with point-to-point measurements.

The company has also built a trailer exhibit which demonstrates how airmen jam enemy radar en route to targets.

The exhibit will shortly be dispatched on a six-month nationwide tour of military installations and industrial concerns.

Feature of the four-panel exhibit is a "game" which simulates an actual bombing mission, complete with attacking bomber, radar screens, missile launching site and target city. By manipulating the controls of a simulated electronic countermeasures (ECM) station, the operator-visitor may try his luck at guiding his bomber safely to target.

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The National Bureau of Standards has adapted its "Peek-a-boo" rapid information retrieval system for direct-viewing and search of up to 18,000 documents. The mechanical device selects a micro-film of a document, through a cable operated control linkage. A drum containing the documents positions itself so that a viewing screen can receive a magnified image of the micro-film.

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The machine is based on the "microcite" concept and was developed through the Department of Defense to make the reference service more readily available to Government and industry. For information refer to the NBS Office of Technical Information.

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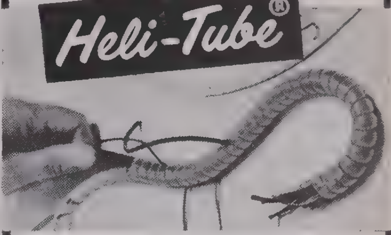

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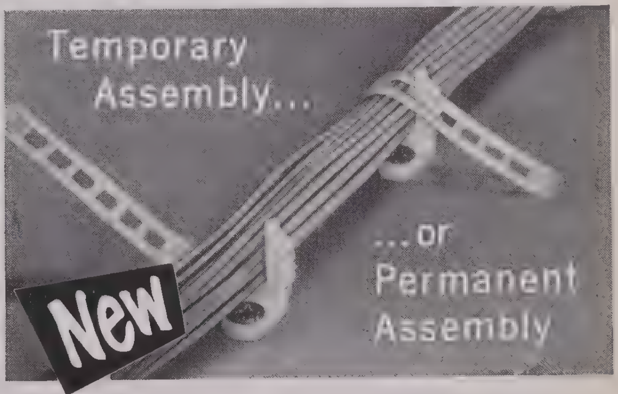

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Needed—A Tactical Advantage

(Continued from page 91)

make is through the application of technology to some of the problems. A suggestion might be a close look at the often inferior position we occupy in the limited, tactical war. We are attempting to put in the hands of our friends, in these small military operations, the tools to win battles in which they are often out-numbered if not just out-maneuvered. How can we so equip a solder in Laos, for instance, so that he will be able to successfully combat the enemy when he finds himself fighting guerrilla tactics, and sometimes even superior forces and armaments? Through electronic technology we can and must provide some of the tools. We must produce for him appropriate equipments that are simple, reliable, effective and inexpensive. Admittedly, such terms are over used, but if we realize the importance of the requirements, we should see that these terms gain new significance.

To build better tanks, guns and other conventional weapons to give to the soldier in the limited war is not enough. By the communists' obvious plan for progress we will be fighting wars in primarily the under-developed countries or on the primitive fringes of semi-modern ones. This means combat in jungles and similar primitive environments. Areas of this type make the battleground friendly to the communist forces of the type employed in Laos and Viet Nam. They have met with such success as to suggest that they will be employed in future campaigns in other countries until such time that the tactic is no longer successful. We may consider this, then, one basic problem. Change the nature of the battleground so as to make it more friendly to us and hostile to our enemy.

The need for better surveillance and communications is clear, and is possibly the most important contribution that can be made by our

(Continued on page 200)

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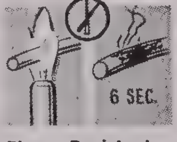
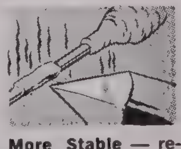


Flame Resistant — will not support combustion.



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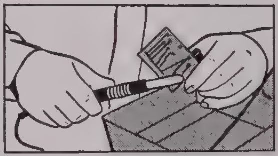
Versatile Put-On Tool Proves Money Saver in Design and Electronics

With the advent of the SELECTRON Process, selective plating, a technique formerly limited to the hobby shop, has now come of age.

SELECTRON is now being used in field repairs, in R & D, and in light manufacturing. Typical applications include gold or rhodium plating of printed circuits, silver plating of bus bar and electrical contacts, repair of flanges on wave guides, precision fitting of bearings for electromechancial devices, and improvement of solderability of stainless steel, aluminum and semi-conductors.

Automated SELECTRON installations are finding use in production plating on isolated areas of transistor tabs and for gold plating of capacitor leads.



One ever-expanding use for SELECTRON is for prototype work. SELECTRON units—occupying only the area of a desk top—are currently electrodepositing almost any platable metal or alloy, from antimony to zinc, upon any conductive basis material.

An information-packed 8-page booklet on its many advantages is available on request from *SELECTRONS, Ltd.* 520 Fifth Ave., New York 36, N. Y.

See us at the WESCON Show, San Francisco, Booth 4827

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3S-G SILICON SEMICONDUCTOR

STRAIN GAGE PRESSURE TRANSDUCER

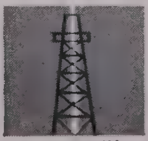
Outstanding features:

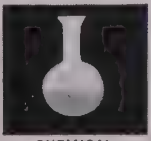
- HIGH OUTPUT d-c SIGNAL
- EXCEPTIONAL ACCURACY
- MAXIMUM RELIABILITY
- INFINITE RESOLUTION
- SELF CONTAINED CALIBRATION
- TEMPERATURE COMPENSATED
- UNEXCELLED REPEATABILITY
- RUGGEDIZED

The Fairchild 3S-G is the first and only pressure transducer with a 5V DC output signal that uses semiconductor materials having piezoresistive characteristics as a transducer sensing element. It is also available with low level outputs of 5-50 MV and ¼ V. This revolutionary transducer is extremely accurate, has an operable temperature range of —65° to 250°F, and is responsive to both static and high frequency dynamic pressures from 0-100 through 0-10,000 psig and psia. It is fully compatible with existing military air, ground and underwater telemetry and industrial systems and resistant to all gaseous and liquid media, including liquid oxygen, strong alkalies, corrosive acids and high energy fuels. Airborne and ruggedized designs are available; both can withstand 35 G's vibration to 2,000 cps with negligible effect. For information on the application of the silicon semiconductor strain gage pressure transducers to your system requirements, write to Fairchild Controls Corp. Dept. 50EI.

wide application in control systems for defense and industry

STEEL


PETROLEUM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Circle 137 on Inquiry Card

Needed—A Tactical Advantage

(Continued from page 198)

industry. The location of enemy forces within a jungle is a most difficult tactical problem. For example, current drone aircraft are impractical for this type of work. They should be smaller so that they could be used by small bands of highly mobile tactical forces. Today this type of craft resemble small racing planes, and require large amounts of support equipment, not to mention personnel and fuel. The obvious requirement is for miniaturized and simplified guidance and surveillance equipment so that the craft could be small enough to meet the requirements of mobile forces.

Aerial surveillance is not enough, and often cannot be achieved, even with the proper equipment. Surveillance *within* the jungle is also required. This is somewhat analagous to the anti-submarine problem. Consideration of this analogy leads to the concept of a sono-buoy type device for the detection of personnel movements in the jungle. It could use either a sonic or interference type personnel detector, or both in combination, linked by radio to appropriate central equipment. The central equipment could, of course, be either ground based or airborne. Large numbers of such devices could be dropped in patterns to provide not only a means of detecting and locating forces, but could also provide knowledge of their movements. An adjunct to such a system could be a "natural noise background monitor." Such a device could detect and indicate the changes in sound level that accompany the movement of forces in any terrain.

For friendly troops operating on reconnaissance or combat patrols in jungle areas, a type of IFF gear similar in effect to what has been used in aircraft could be very valuable. This could be a type of miniaturized, short range, coded transmitter-receiver with a built in

(Continued on page 202)

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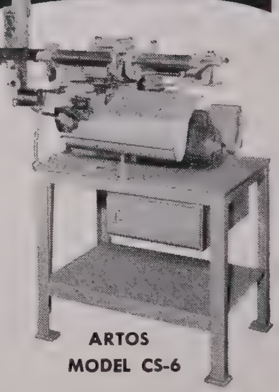
FULLY AUTOMATIC PRODUCTION OF FINISHED WIRE LEADS

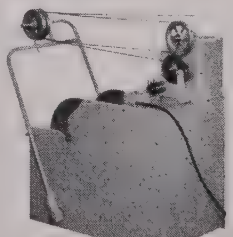
. . . any operator can produce 3,000 or more leads per hour in any insulated wire to 10-ga.

END wire stripping bottlenecks! You can measure, cut off and strip insulated wire with this *fully automatic* ARTOS machine . . . over 6,000 leads per hour with some types of wire.

With unskilled labor, solid or stranded wire leads are produced in lengths from 2″ to 194″—and stripped up to 2″ at one or both ends.



ARTOS MODEL CS-6



(*Left*) AE-563 PREFEEDER

Completely automatic, self-adjusting unit with ⅓ hp. motor. Requires no attention after wire has been threaded into stripping machine. Heavy reels roll into cradle or can be mounted on a shaft.

ALSO AVAILABLE: Extra equipment to mark leads with any code. Other machines also attach prefabricated terminals in strip form to your wire leads.

WRITE FOR FREE BULLETIN

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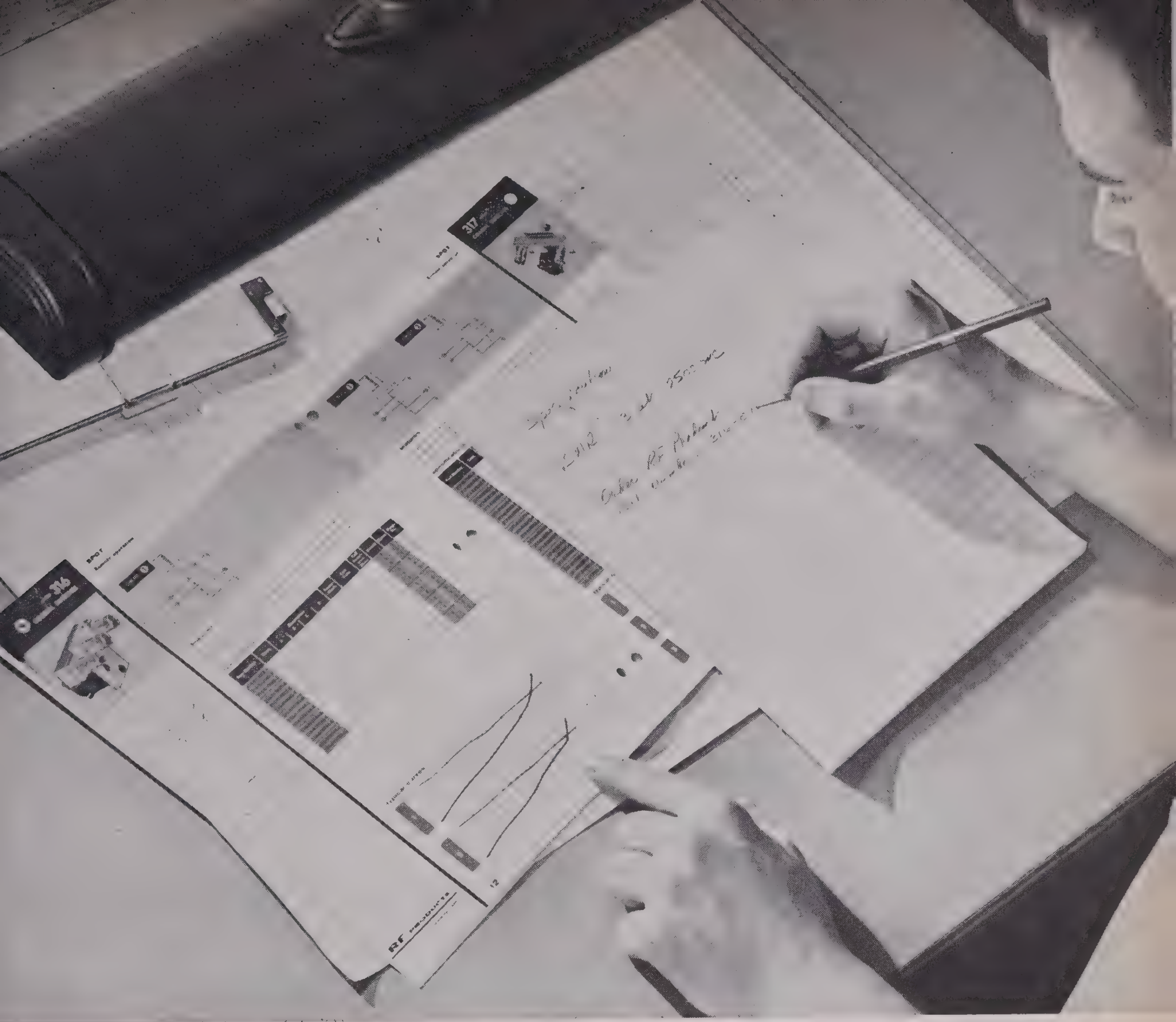

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You'll also find that these switches successfully combine ruggedness with the highest standards of precision: spring-leaf switching blades, gold-plated silver contacts and impedance matched connectors keep insertion loss and VSWR (1.3 @ 4,000 MCs) low, Crosstalk high (in decibels down); electro-mechanically actuated models operate and release in 8 to 20 milliseconds, depending on type and function, with a proven mechanical life of 1,000,000 cycles minimum when operated under 10 cps.

And, don't forget that RF Products, pioneers in the development of the coaxial switch, will continue to offer you design and engineering services whenever you need them. Whether you order a switch from the catalog or a switch designed to meet your exact specifications, you can be assured of the same high quality and service.

For details on our new line of standard switches, write for catalog DK 61.

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Circle 59 on Inquiry Card

Needed—A Tactical Advantage

(*Continued from page* 200)

destruct mechanism.

Communications equipment of such a nature that it could be used day or night, without great risk of detection or monitoring, would multiply the effectiveness of small forces. This equipment would in all probability be limited to line of sight and would probably not be radio. There are ways to achieve this mode of communications. It is now only necessary to use the available concepts to develop the specific equipment needed.

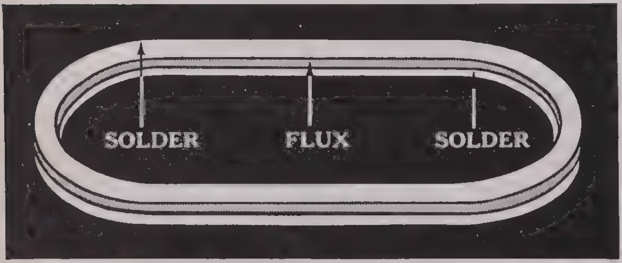
Limited warfare calls for increased psychological techniques. The application of advanced technology to simple devices here might have telling effect. The well trained and indoctrinated troops (like those employed against the French in Viet Nam) could be combatted, in part, with psychological methods. One means of making the jungle seem less friendly to such troops would be to plant large numbers of sound amplifiers in tree tops, conceivably with sound reflectors. Such units could, for the life of their batteries, amplify jungle noises on an intermittent basis.

The problem of making maximum use of indigenous troops is often great because of inadequate time to train them in the proper use of weapons and techniques. This would appear to be a fertile area for the use of teaching aids that have recently been developing so rapidly in our country. A significant speed-up in training and indoctrination of such troops could, in view of past experience in Korea, conceivably alter the outcome of conflict.

A conventional weapon of considerable effectiveness is the land mine. One limitation of the device is the fact that it is indiscriminate; it will blow up if anyone triggers it, friend or foe alike. The development of a device to be built into a mine so that it could be made inoperative by coded transmission by troops or vehicles operating in its immediate area could make the game of mining and counter-mining more effective. The land mine is certainly not the only conventional weapon whose effectiveness could be improved through the use of electronic concepts. There must be many others whose very functions make them ideal for compatible use with electronic devices and equipment.

The business of providing equipment for the limited war does not have the charm and glamour of the missile and space business, but it is a very necessary business—our future may well depend on our capability to produce in this area. If we devote as much time and effort thinking about miniaturized systems for this as we have for space and strategic systems, if we spend as much time thinking about clever designs as we have done in other areas, if we really analyze the problem, it would appear certain that simple, reliable, effective equipment for limited war would result. It could well be that such developments represent a bright future for many individuals and companies within the electronic industries. * * *

NEW solder development!



ALPHA flux-filled washers open a whole new field of automatic soldering opportunities!

Unique design insures maximum surface-to-surface contact on close-fitting parts, complete peripheral fluxing. Produced through a special ALPHA process, they provide, for the first time, completely new soldering opportunities.

ALPHA makes a wide range of flux-filled and solid preforms *Request information today!*

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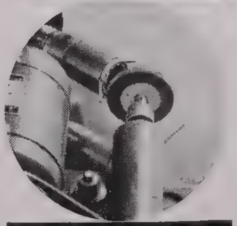
PREDICTABILITY—
A Key to Reliability

Cleaning and polishing small component parts, instruments and control mechanisms.



Breaking edges, shaping to slight radius, touching-up and scores of other operations.

Relieving stress concentration and blending-in to reduce danger of fatigue failure.

Advanced technologies demand accurate predictions of performance in tools as well as materials. Predictability in tools used is basic to reliability in products made.

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Bendix Bulletin

MIL-TYPE UNITS SET PACE FOR FULL LINE RELIABILITY

"Dynamic testing" part of everyday quality story at new Bendix plant

Bendix mil-type power transistors and rectifiers give engineers unusually wide design freedom on military equipment applications. And these units are well suited to both electrical and environmental conditions because of their rugged dependability.

As a matter of fact, high reliability characterizes our entire semiconductor line. For, at Bendix, we apply extra precautions—such as "dynamic testing"—across-the-board daily. Thus, you get "an extra measure of value" *no matter what Bendix type you buy*.

Specially suited to high-current switching, audio amplification, small motor and servo drive applications, our mil-type transistors feature rugged reliability to meet electrical and environmental conditions. The three rectifiers are characterized by low forward drop and low reverse leakage current. Besides power rectification, they're ideal for magnetic amplifier and DC blocking circuits.

MAXIMUM RATINGS AND TYPICAL OPERATION OF MILITARY POWER TRANSISTORS

TYPE NUMBER	MIL-T-19500/	MAXIMUM RATINGS						TYPICAL OPERATION	
		V_{cb} Vdc	V_{ce} Vdc	I_c Adc	P_c W	T_j °C	T storage °C	h_{FE}	at I_c Adc
2N297A	36A (SigC)	−60	−50	5	35	95	−65 to +95	70	0.5
2N331	4A	−30	−12	0.2	0.075	85	−65 to +85	50	0 001
2N1008B	196 (SigC)	−60	−55	0.3	0.4	100	−65 to +100	80	0.01
2N1011	67 (SigC)	−80	−70	5	35	95	−65 to +95	55	3.0
2N1120	68 (SigC)	−80	−70	15	45	95	−65 to +95	35	10.0
2N1430	SCL7002/25A	−100	−80	10	50	100	−65 to +100	70	5

Ideal for such applications as: **HIGH CURRENT SWITCHING • AUDIO AMPLIFICATION • SMALL MOTOR AND SERVO DRIVERS**

MAXIMUM RATINGS OF MILITARY POWER RECTIFIERS

TYPE NUMBER	*MIL-T-19500/	Io at 150°C	PRV Vdc	LIb at 25°C	Epp Vrms	LIb at 150°C
1N1614	162 (SigC)	5 Adc	200	50 µAdc	140	500 µAdc
1N1615	162 (SigC)	5 Adc	400	50 µAdc	280	500 µAdc
1N1616	162 (SigC)	5 Adc	600	50 µAdc	420	500 µAdc

*These were MIL-E-1/1240, 1241 and 1242 respectively.

Ideal for such applications as: **MAGNETIC AMPLIFIERS DC BLOCKING CIRCUITS • POWER RECTIFICATION**

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Circle 142 on Inquiry Card

Beading Machine

(*Continued from page* 111)

has been averaging less than 10 out of each 1,000.

The metal hood at the top right of the machine provides draft protection. A window in this hood permits in-process inspection of the sealing operation. The machines are laid out to permit maximum accessibility for routine inspection and monitoring. All drives are either through cams or linkages, permitting a minimum of adjustments; while the basic drive of the unit is through a crossover cam, allowing smooth and accurate indexing. An examination of the closeup of the machine in the photograph indicates how maintenance is kept to a minimum: all moving parts and the heads are readily accessible. Dies are easy to reach, as are the feeds and other parts which require periodic lubrication of inspection. One attendant services six machines, and skilled operators are no longer required to check the flow or to inspect and sort the finished parts.

* * *

Our Technical Resources

(*Continued from page* 90)

in product lines and personnel are prevalent. In certain respects, this turmoil within industry has weakened our national technical strength at a time when it must be used effectively in all respects.

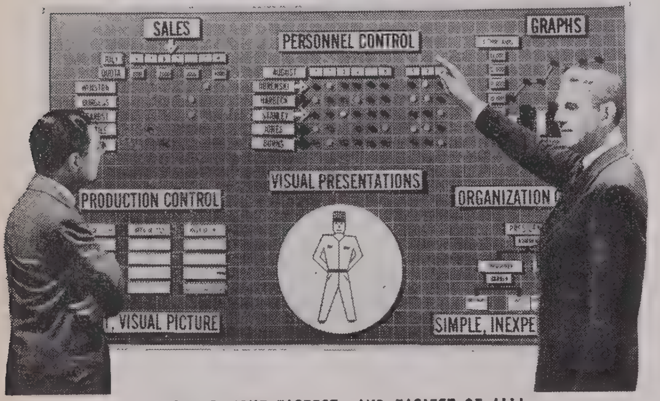
There are many positive corrective actions that can be taken to achieve a more effective application and distribution of our technical resources. A few suggestions are as follows:

1. Governmental policies covering competitive bidding for research and development programs should be carefully reviewed in the interests of more efficient and effective use of both our technical and financial resources. It now often occurs that research and development competitions are handled in such a manner that numerous companies find it necessary to devote large numbers of engineers (sometimes on the order of 100 or more, each) at heavy costs (often in the hundreds of thousands of dollars, and sometimes in the low millions of dollars) in the preparation of proposals. Considering the large number of such competitions and remembering that the losers greatly outnumber the winners, the tremendous drain on our scientific and financial resources—at the proposal stage—is obvious. The situation embodies serious duplications of effort, has a generally unavoidable negative impact on work already under contract, and has far reaching financial implications. It has become a particularly significant problem with the shift in emphasis from production to research and development, and with the associated hectic competitive struggles to achieve positions of prominence in this new scientific era.

2. The importance of realistic and timely long range planning is well recognized by both the Goverment and Industry. However, there appears to be a need for much improvement in this area to reduce the occurrence of program cancellations and cutbacks. The

(*Continued on page* 206)

VISUAL **MAGNETIC** CONTROL



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Very Small, Low Noise Mixer-Preamplifier

Newest in LEL's broad line of mixer-preamplifiers, the XBO-8 combining an Orthomode mixer and a Nuvistor preamplifier provides excellent noise figure, small size, very low power drain at lower cost. Other models are available for operating ranges from 3.95 to 10.5KMC.

SPECIFICATIONS

Gain	22db
IF	30, 60 or 70mcs
Bandwidth	12mcs
Noise figure	Less than 8db
Power	+40 VDC at 12ma 6.3 VAC at 0.4amp
Size	1-7/8" x 1-1/8" x 4"
Weight	10ozs.
Material	Aluminum, silver plate, rhodium flash

Send for 48 page Microwave RF/IF Equipment Catalog

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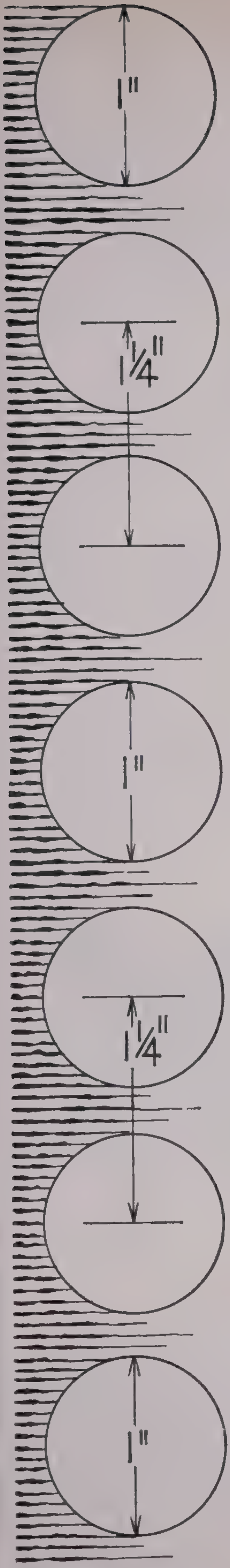
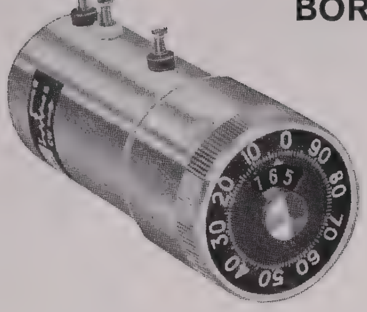
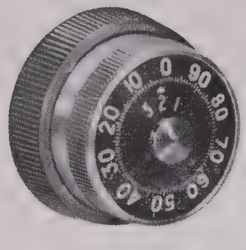


NEW 1" DIAL

BORG 3000 SERIES MICRODIAL®



Model 3021
Without Brake
With 2100 pot
Actual Size



Model 3021-3
With Brake
Actual Size

The new Borg 3000 Series concentric-scale Microdial is a 1" diameter, ten-turn, precision turns-counting dial. Ideal companion units for the ⅞" Borg 2100 Series and 2440 Series Micropot® potentiometers, these dials can be mounted on 1¼" centers — 40 brakeless models would fit conveniently on this page! ¶ The 3000 Microdial offers the instrument designer functional color-keying versatility and distinctive panel enrichment. Five brake knob colors and three combinations of numeral and background colors are standard. Custom treatment can be given to control knobs, brake knobs, numeral configuration and color. ¶ Despite miniaturization, the 3000 Microdial is easy to read and offers the same smooth, silent gear action inherent with all Borg Microdial Series. Contact your nearest Borg technical representative, distributor or write for complete data.

STANDARD MODELS

For ⅛" Dia. Shafts (without brake):

Models	Numeral Colors
3021	White numerals on black
3022	Black numerals on white
3023	Fluorescent numerals on black

For ¼" Dia. Shafts (without brake):

Models	Numeral Colors
3041	White numerals on black
3042	Black numerals on white
3043	Fluorescent numerals on black

For Models With Brake:

Add one of these dash numbers: 1=White brake knob 2=Black brake knob 3=Red brake knob 4=Dark gray brake knob 5=Light gray brake knob

BORG

BORG EQUIPMENT DIVISION
Amphenol-Borg Electronics Corporation
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Our Technical Resources

(*Continued from page* 204)

disruptive impact of such cancellations and cutbacks on our scientific talent needs no discussion here.

It is recognized that cancellations and cutbacks are not completely avoidable, particularly in the presence of rapid changes in technology. Nevertheless, it is believed that occurrence of the needs for such action can be reduced significantly through the development of competent, realistic, and unbiased planning techniques which are in synchronism with the times.

3. Special care should be exercised to minimize the premature application of new procurement philosophies. The habits of nations, like the habits of individuals, cannot be changed rapidly. Further, it is risky to discard the old for the new system until the faults of the new system are known. For example, the weapon system concept could have been introduced with far less disruption to the electronics industry and with fewer logistic problems. As another example, applications of the tri-service aircraft concept should be timed with particular care in order not to jeopardize the continuity in the strength of the individual services.

4. There exists a need for greater and more timely direct contracting to the specialized contractors who develop and manufacture components, sets, and subsystems. This directly sponsored work provides an important foundation for the systems contractor, and thereby complements the weapon system concept while permitting the GFAE approach when applicable. The beneficial results are many, including: continuity in the technical strength of equipment manufacturers, minimization of unnecessary duplication of effort, improved logistics, lower procurement costs through greater standardization, and timely availability of equipments and data for use by system designers.

5. Each contractor should be careful not to dissipate his scientific and managerial talents through excessive diversification. Certainly, each contractor must take the steps necessary to ensure profitable continued growth of his company. However, concurrent with the drastic changes in the nature of Government business, some contractors have ventured out of reasonable bounds with the result that much technical and managerial talent has been diluted or wasted.

Our success in achieving our national security objectives in the presence of both the rapid technological advancements and the fluidity in the balance of world powers is critically dependent on our technical resources. Therefore, it is vital that these resources be used efficiently, effectively, and with a high degree of continuity despite an atmosphere of change. To properly marshall these resources is not only one of our greatest challenges, but it promises to provide the greatest rewards in terms of the economical accomplishment of a coherent national effort toward security within the structure of our precious way of life.

* * *

ARNOLD/TOROIDAL COIL WINDER

sets up quickly...easy to operate...
takes wide range of wire sizes

SPECIFICATIONS:
- Min. finished hole size: .18 in.
- Max. finished toroid O.D.: 4.0 in.
- Winding speed: 1500 turns/min.
- Wire range: AWG 44 to AWG 26
- Dual, self-checking turns counting system
- Loading (wire length) counter
- Core range: 1/4" I.D. to 4" O.D. to 1 1/2" high

LABORATORY USE
- Change wire and core size in 45 sec.

PRODUCTION USE
- 1500 turns per minute
- Insert core and load in 20 sec.

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Instrument Cases
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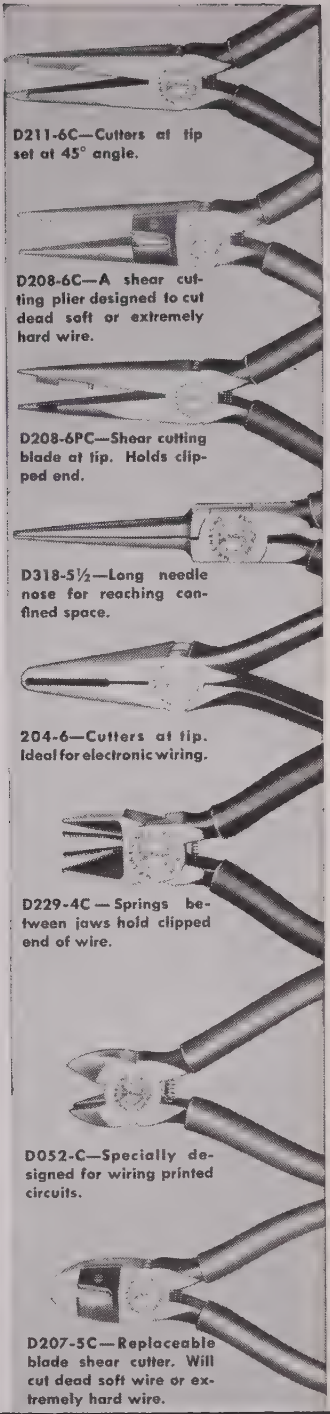

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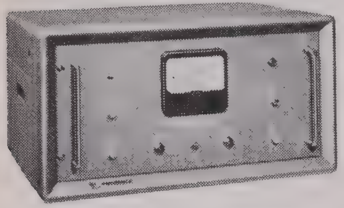

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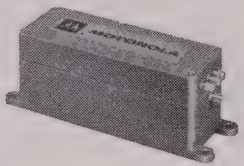

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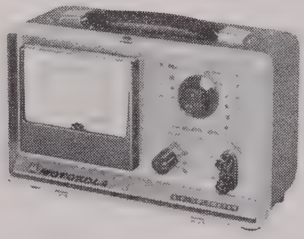

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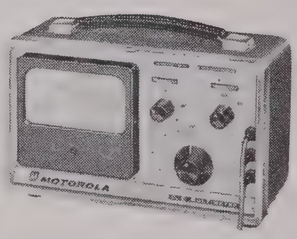

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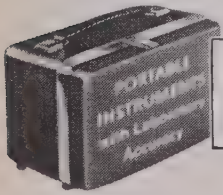

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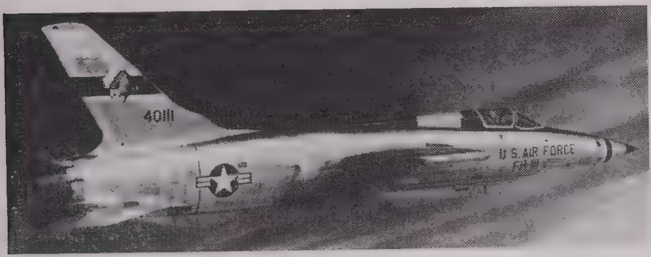
Tele-Tech's ELECTRONIC OPERATIONS

The System Engineering Section of ELECTRONIC INDUSTRIES • AUGUST 1961

SYSTEMS—WISE . . .

▶ A 55-ton satellite "space Chamber" for duplicating conditions 200 miles from earth has been delivered to the Sunnyvale plant of Lockheed Missiles and Space Co. The High Vacuum Orbital Simulator (HIVOS) will be in operation by Nov. Principal space craft to be tested in the $1.6 million system will be Lockheed's Agena, used in USAF Discoverer, and Midas satellite programs.

"MATING" FOR THUNDERCHIEF



The F-105D is having an all-weather reconnaissance and battlefield surveillance system mated with it's all-weather weapons system. Housed in the bomb bay, it will take, process, print and eject photos from the air to a ground command station in minutes.

▶ New oceanographic camera and synchronized electronic flash system has been developed by Edgerton, Germeshausen & Grier, Inc., for use with the bathyscaphe Trieste. Designed for attachment to the outside hull, the units are able to withstand pressure over 8 tons/sq. in. at ocean depths to 37,500 ft. It will also withstand near-freezing temps. prevalent at extreme ocean depths. System contains two 35 mm cameras capable of taking 500 pictures at a loading.

▶ Submarine navigation at periscope depth will be improved by use of a modified aircraft sextant atop the periscope. The KS-100 Semi-automatic Photoelectric Sextant, built by Kollsman Instrument Corp., compensates for hull rocking and periscope bending; automatically tracks a celestial body for position fix.

▶ Special Air Force camera that looks like an over-size anti-aircraft gun has been photographing missiles, satellites and planets in broad daylight. Consisting of 19 long-barrelled 5-in. refracting telescopes lined to as many TV-like image-orthicon tubes, the giant "Facet-Eye Camera" is installed at the Air Force Missile Development Center, Holloman Air Force Base, New Mexico. Built by International Telephone & Telegraph Laboratories, the system recently captured continuous bright-image views of Venus and Jupiter in broad daylight.

▶ Lenkurt Electric Co., Inc., is producing $900,000 worth of AN/FCC-17 Multiplexer Sets for use in SAC's flying command posts. The fully transistorized system has a max. capacity of 600 voice channels, for either fixed office or tactical use.

▶ Air traffic control system, made by Avco Corp., Electronics and Ordnance Div., for the U.S.A.F. is in Atlantic City, N. J., being tested. The AN/GSN-11 directs up to 24 aircraft—18 inbound, 6 outbound—at the same time. A computer evaluates all information needed to direct private, jet and military interceptor aircraft.

▶ The Atlantic Refining Co. has opened a computer center at their Phila., Pa., refinery. Besides product inventory, payrolls, etc., it will be used in management decisions of refinery operation, marketing policies and product development. Center consists of IBM 7070, 704 and 1401 systems.

▶ U. S. Navy contract for a system to automatically stack and store aircraft engine parts awarded to Electro Nuclear Systems Corp. System is for Alameda N.A.S., Calif. It will store 500 lb. pallets at a rate of 185/hr. Automatic controls use both digital and analog systems.

▶ G.E., under contract from Shipbuilding Div., Bethlehem Steel Co., is designing, manufacturing, and supervising installation of an advanced automated cargo handling system aboard three new Grace Line passenger/cargo vessels. The automated equipment will include two platform-type cargo elevators and three integrated pallet-handling elevator-conveyor systems.

▶ General Telephone & Electronics Corp. has received an extension contract for $1.2 million for ground stations for the U. S. Army's ADVENT program.

▶ A system which translates one language into another by means of an IBM 7090 computer has been unveiled by Machine Translation Inc. The Unified Transfer System (UTS)—translated an article from Pravda into English at 60,000 words per hour. The UTS system has been designed for use in general purpose computers.

ATOMIC POWERED WEATHER STATION

Generator being lowered into a half-buried cylinder for test at the Martin Co., Baltimore, Md. Pellets of Strontium 90 provide 5 w for storage in rechargeable batteries for radio transmissions every three hours. Radio range is 1500 miles. Installation scheduled for late this summer in Northern Canada.

For The U. S. Air Force . . . . . .

Designing a

By **MAJOR DONALD B. NOWAKOSKI**
and **RICHARD C. BENOIT, Jr.**
Rome Air Development Center
Rome, New York

AIR FORCE communications requirements are increasing at a high rate. Data must be transmitted at very high rates at the expense of band-width and channel space to achieve the reaction capabilities required. This simply means that better use must be made of the medium.

The soundest approach to this problem is the use of multiplexers. They must be flexible enough to allow their use over almost any available medium, and capable of efficiently saturating the transmission mode.

The AN/FCC-17 multiplexer[1] is the Air Force approach to the problem of multiplexing needs. It is believed that it will meet these needs and further, that it will grow with the increasing requirements which are certain to be imposed upon it as global communications systems mature.

Reason for Selecting

The use of frequency division techniques in the AN/FCC-17 as opposed to time division techniques was selected for the following reasons:

a. To provide compatibility, operating flexibility and interconnectability with the majority of the military and commercial systems existing in the U. S. and overseas.

b. Frequency division techniques permit the greatest use of the media in medium and high density systems.

c. The inherent ability to expand a properly designed frequency division system in an economical manner.

d. The ability to drop and reinsert small numbers of channels at intermediate points in an economical manner.

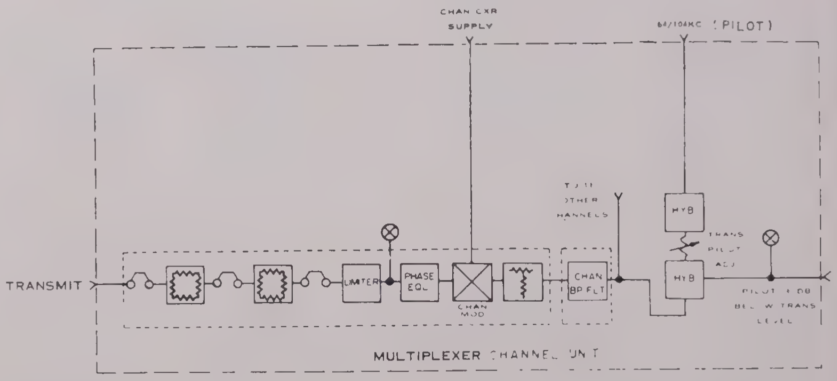
This development will result in a high quality, flexible, expandable transistorized voice frequency multiplex facility employing SSB frequency division modulation techniques. It is designed for optimum employment of a nominal 4 KC channel. A basic 12 (4 KC) channel module has been established. The equipment is designed for expansion of the facility to 600 channels or more by means of flexible group modulators. This basic 12 channel module is standard throughout the multiplex configuration

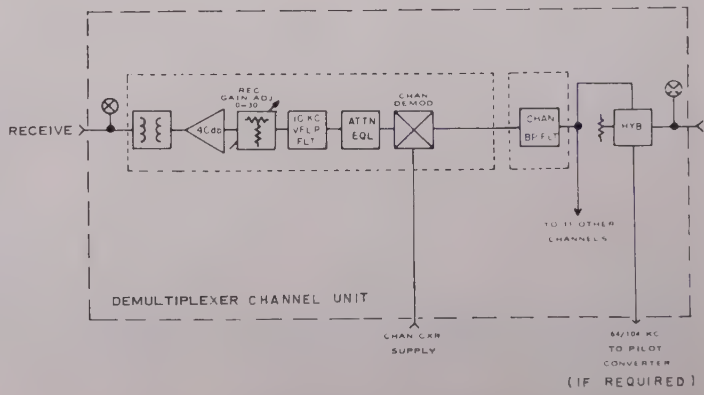
The design concept is the optimization of the 60 channel system, mechanically and electrically. This capacity is expected to be the most common system density required. The tactical package will be somewhat smaller in size. A slight mechanical and electrical penalty is incurred when employing the 12 channel modules singly. However, ready expansion is realized without degradation.

The AN/FCC-17 is being designed for high quality operation on circuits consisting of up to six tandem links covering a total of 6000 miles. The length of a typical link may be as much as 2500 miles. It is expected that some time in the future 15,000 mile circuits will be encountered. We the authors think that the basic electrical design of this equipment will accommodate these circuit requirements.

Auxiliary Items

Under the current program initial deliveries will consist of





> *The Air Force, as with all military services, must maintain world wide, high capacity communications links. With a crowded frequency spectrum the answer is multiplexers. Equipment must be compatible with existing facilities and expandable from 12 channels to 600 channels. A system meeting all of these requirements is under development and is described here.*

Frequency Division Multiplexer

multiplex facilities for radio transmission only. Development is also being pursued concurrently on auxiliary items which will permit use of the basic AN/FCC-17 components on wire and cable facilities. These include the telephone repeater; companders; power amplifiers; equalizers; and regulators. In addition, 12 to 60 (4 KC) channel equipment is being configured for transportable/mobile tactical use in such systems as the Tactical Air Control System, System 412 L, etc. The repeater, as an example, will be fully transistorized and designed for completely unattended operation. In such units as this, optimum inherent automatic control and regulation will be prime features.

The basic multiplexer, AN/FCC-17, will permit nearly optimum transmission of voice, digital data, and similar signals. The transmission characteristics exceed any other known quality standards, as dictated by the stringent technical and loading requirements of digital data and high speed telegraphy. Special attention is being given to phase delay, frequency response, and synchronization to achieve these high quality standards.

The channel phase delay will not differ by more than 165 μsecs between any two frequencies in the band 600 to 3200 CPS and not more than 100 μsecs in the 1000 to 2500 CPS range for a single back-to-back terminal. The channel frequency response will be within 1 db from 325 to 3450 CPS for a single link.

The level stability will be maintained within 2 db for a 6 link 6000 mile in-tandem circuit. The terminal gain stability will be within 0.2 db from all causes without the use of regulators. Drop levels will

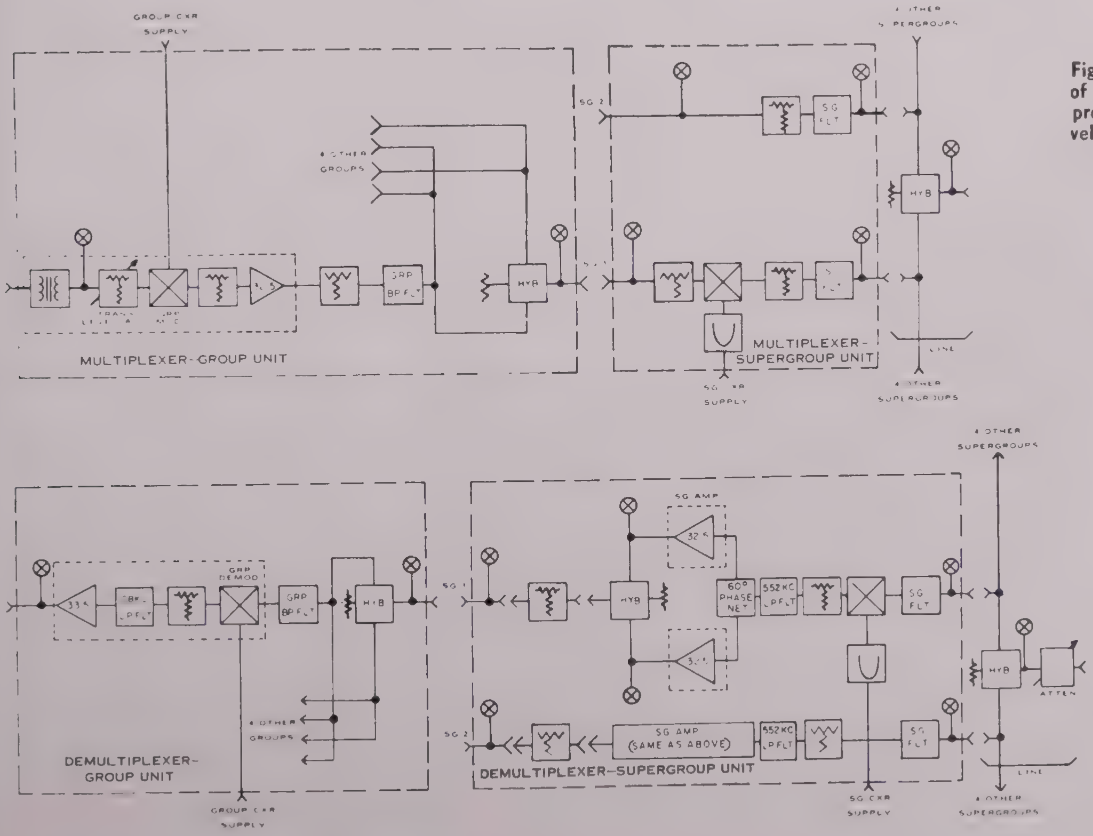
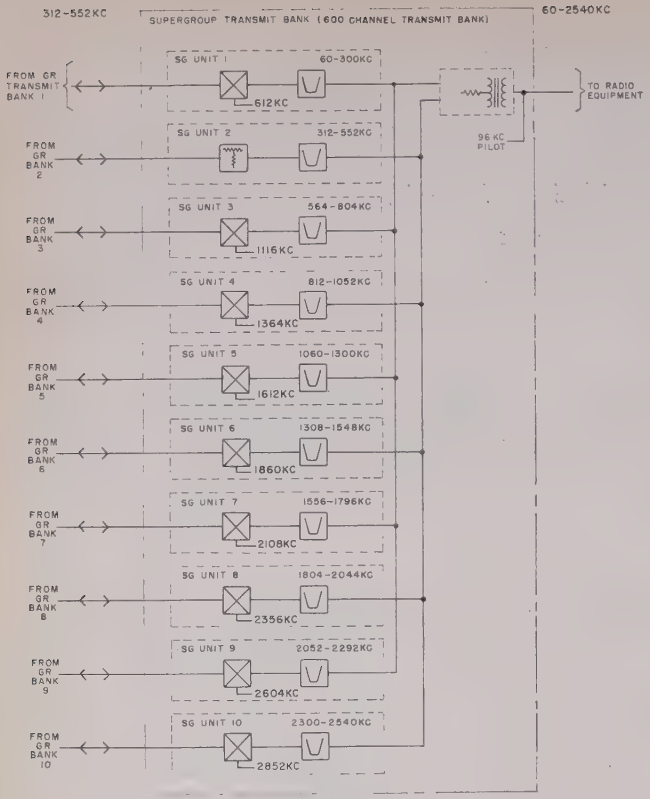


Fig. 1: Block diagram of the multiplexer presently being developed.



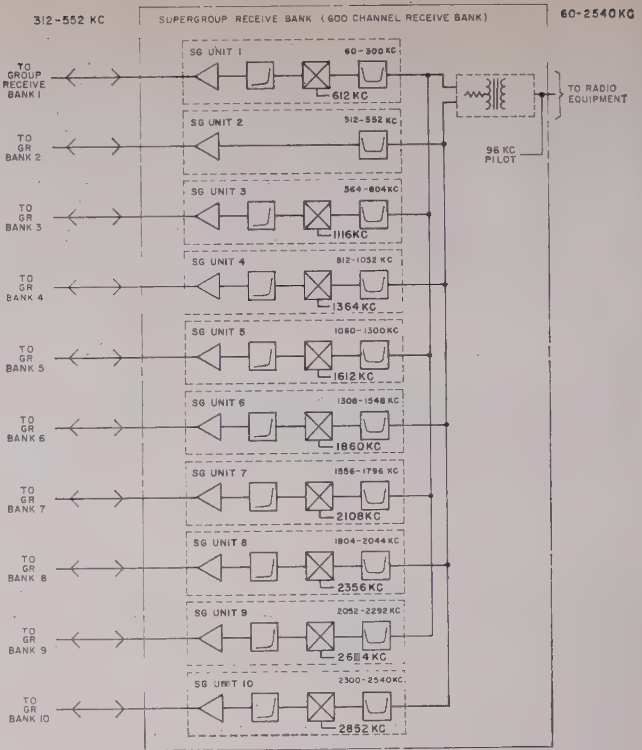


Fig. 2 (left): Diagram of supergroup (600 channels) transmit bank
Fig. 3 (above): Supergroup (600 channels) receive bank is shown

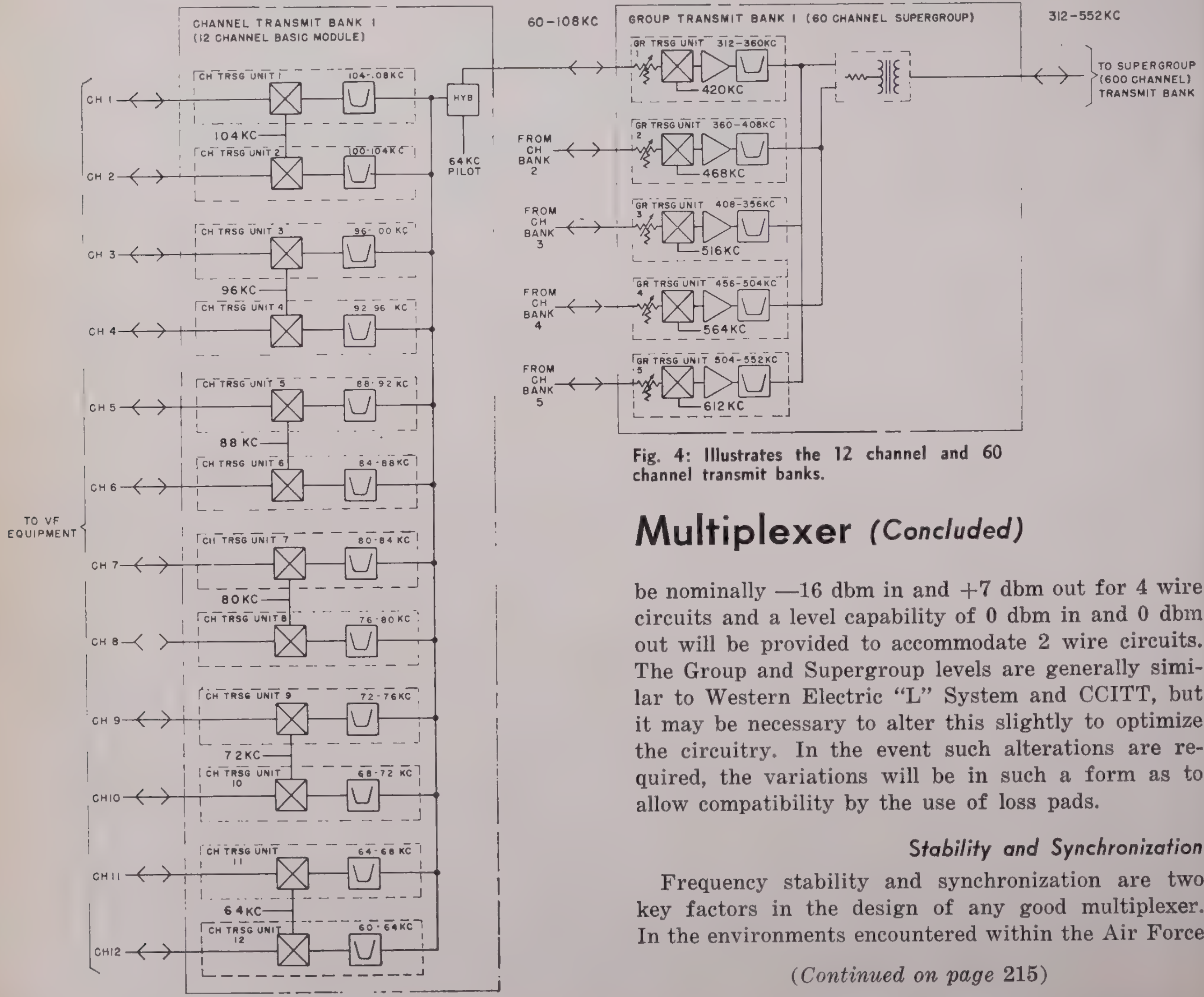


Fig. 4: Illustrates the 12 channel and 60 channel transmit banks.

Multiplexer *(Concluded)*

be nominally —16 dbm in and +7 dbm out for 4 wire circuits and a level capability of 0 dbm in and 0 dbm out will be provided to accommodate 2 wire circuits. The Group and Supergroup levels are generally similar to Western Electric "L" System and CCITT, but it may be necessary to alter this slightly to optimize the circuitry. In the event such alterations are required, the variations will be in such a form as to allow compatibility by the use of loss pads.

Stability and Synchronization

Frequency stability and synchronization are two key factors in the design of any good multiplexer. In the environments encountered within the Air Force

(*Continued on page* 215)

COMPUTERS AND OTHER ELECTRONIC INSTRUMENTS demand resistors which give predictable performance in a small space and high ambient temperatures. This is a good description of Corning tin oxide film resistors, which are now competitive in price with other makes.

Tin oxide and glass are among the most stable materials. They are also low in cost.

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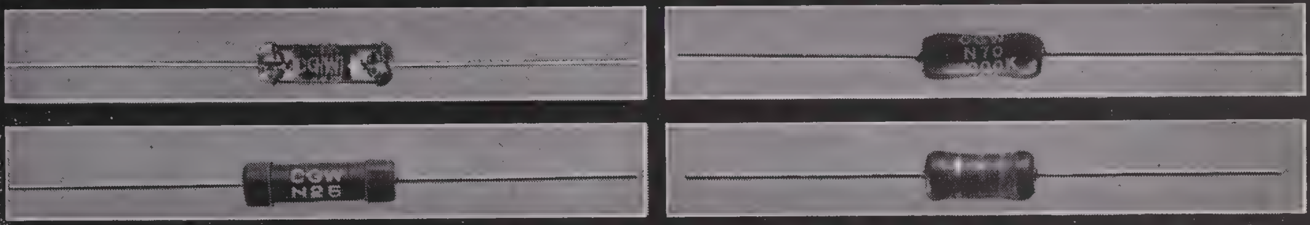
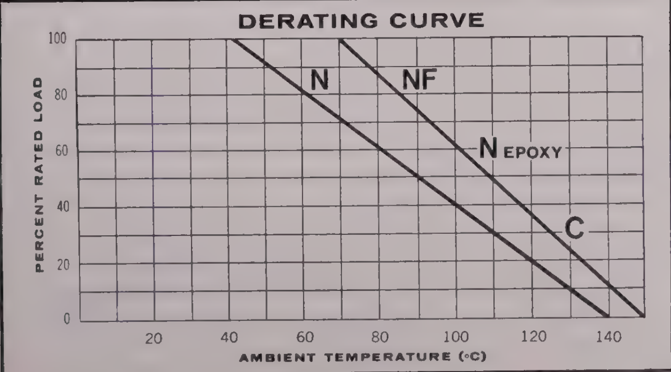
You have resistors with excellent reactive properties. With a shelf life of 0.1 to 0.2% per year. With noise levels lower than 0.1 microvolt per volt. And with typical values like these:



TYPE	DESCRIPTION	CORNING MODEL	WATTAGE	RESISTANCE (ohms)	TC	LOAD LIFE	OVERLOAD	MOISTURE RESISTANCE
NF	Glass ENCAPSULATED MIL-R-10509C, Char. B	NF60 NF65	⅛ ¼	100 100K 100 348K	150ppm/°C. −55 +150°C.	0.3%	0.03%	0.2% (Char. B)
N EPOXY	MIL-R-10509C, Char. B	N60 N65 N70	⅛ ¼ ½	10 133K 10 499K 10 1Meg	150ppm/°C. −55 +105°C.	0.5%	0.03%	0.5% (Char. B.)
N	MIL-R-10509B, Char. X	N12 N20 N25 N30	¼ ½ 1 2	100 133K 10 500K 10 1.5Meg 30 4.12Meg	150ppm/°C. −55 +105°C.	0.35%	0.1%	0.15% (Char. X)
C	Lowest cost film resistor; silicone insulation MIL-R-11C	C20 C32 C42	½ 1 2	51 150K 51 470K 10 1.4Meg	150ppm/°C. −55 +125°C.	1.5%	0.2%	0.3%

Note: Noise level for all models is less than 0.1 uv/v of applied signal.



For quantities of less than 1000, contact the nearest Corning distributor. For data sheets on Corning Type NF, N, N-EPOXY or C resistors, write CORNING GLASS WORKS, 546 High St., Bradford, Pa.

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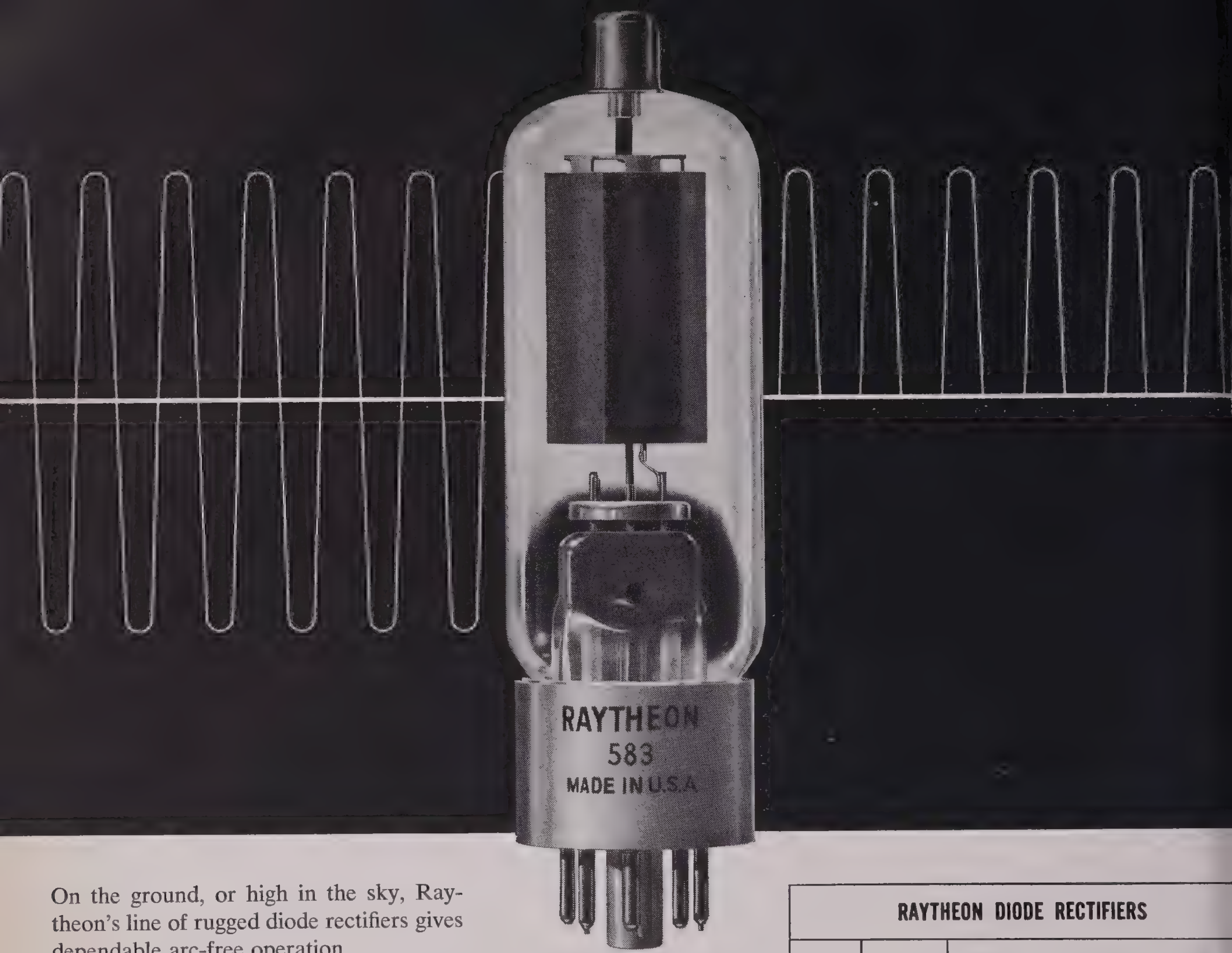

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The reliability of Raytheon diode rectifiers is the result of exceptional care in design and manufacture . . . with no compromise in quality control. Gold-plated plates and zirconium coatings assure reliable operation at high voltages. Cathodes are heliarc welded. Higher exhaust temperatures mean less gas and longer life. For more information on Raytheon's growing line of dependable diode rectifiers, please write: Raytheon, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.

RAYTHEON DIODE RECTIFIERS

		HEATER		MAX. PLATE RATINGS		
TYPE	SERVICE	VOLTS	AMPS	PEAK INVERSE (VOLTS)	PEAK CURRENT (AMPERES)	AVERA CURRE (AMPER
583*	H. W. RECT. (to 36,000 ft.)	2.5	4.9	17,000	0.250	0.06
	CLIPPER DIODE (to 36,000 ft.)	2.5	4.9	15,000	8.0	0.24
3B24W } 3B24WA* }	H. W. RECT. (HALF FIL.)	2.5	3.0	20,000	0.150	0.03
	(FULL FIL.)	5.0	3.0	20,000	0.300	0.06
3B26	CLIPPER DIODE	2.5	4.75	15,000	8.0	0.02
3B29	H. V. RECT.	2.5	4.9			
	(OP. 1)			16,000	0.250	0.06
	(OP. 2)			7,700	0.300	0.08
	(OP. 3)			5,000	0.300	0.09
	CLIPPER DIODE	2.5	4.9	10,000	8.0	0.01
4B31*	H. W. RECT.	5.0	5.0	16,000	0.470	0.1
	CLIPPER DIODE	5.0	5.0	16,000	12.0	0.0

*Mil-Std-200E Preferred Type

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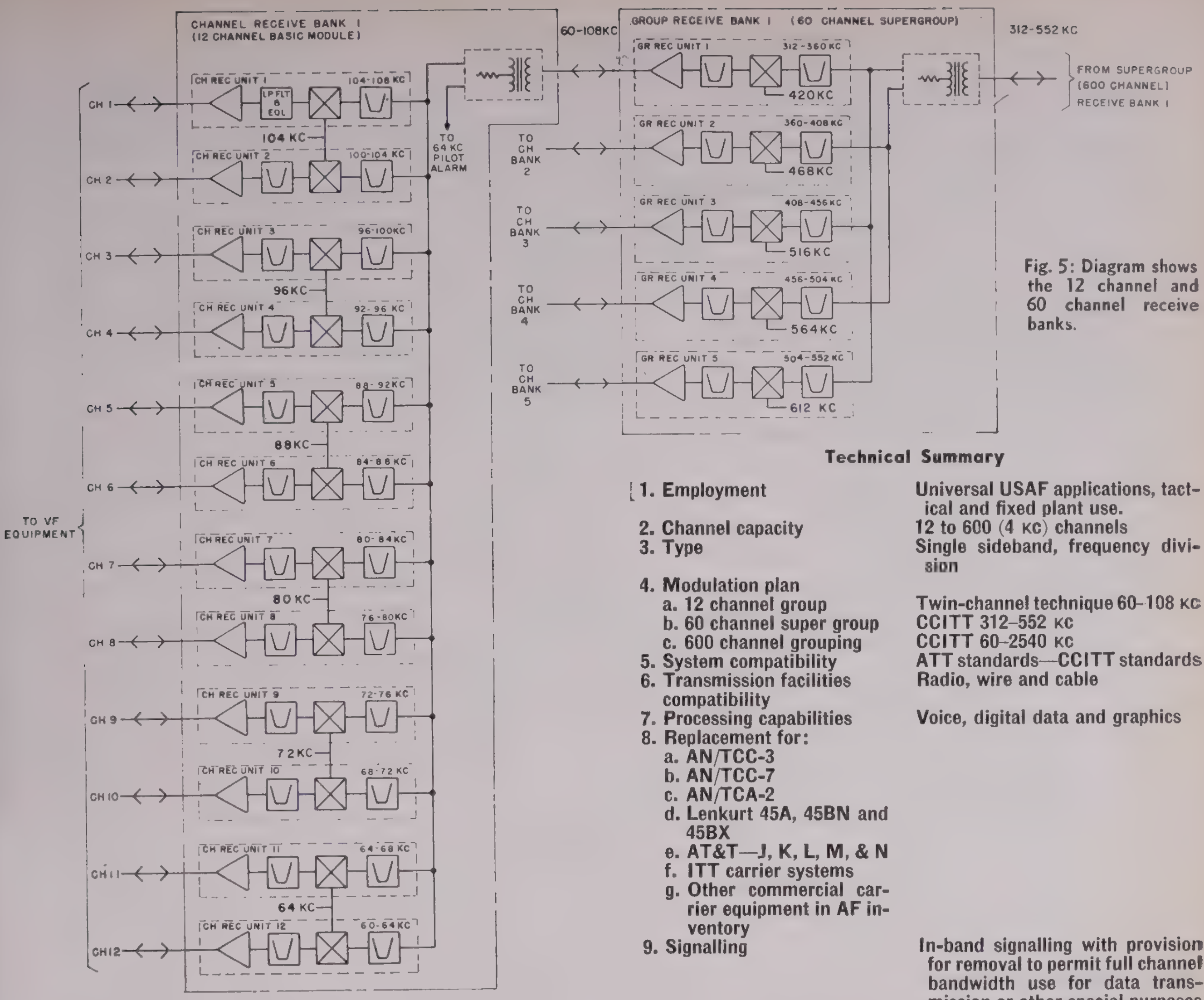

Fig. 5: Diagram shows the 12 channel and 60 channel receive banks.

Multiplexer *(Continued)*

(*Continued from page* 212)

communications complex, such factors as jamming, long term fades, interference of many types, and other hindrances dictate a high degree of inherent frequency stability. As such, the frequency stability requirements have been established at a maximum deviation of 2 CPS drop-to-drop for a three-month period without synchronous correction. Synchronization is standard. It will be used except under those deleterious conditions where the sources of synchronizing references are mutilated.

System synchronization may be achieved on an end-to-end basis in either of two ways. The first method uses a single 64 KC pilot tone. Tone operates in conjunction with a frequency correction device at the remote end which will correct for accumulative multiplex system error. The second approach, which is optional, employs the frequency difference between two pilots within a 12 channel group. This will give a reference at the remote terminal, to the transmitting oscillator frequency and will correct for transmission media errors in addition to accumulative multiplex equipment errors. In either instance the pilot fre-

(*Continued on page* 216)

Technical Summary

1. Employment	Universal USAF applications, tactical and fixed plant use.
2. Channel capacity	12 to 600 (4 KC) channels
3. Type	Single sideband, frequency division
4. Modulation plan	
a. 12 channel group	Twin-channel technique 60–108 KC
b. 60 channel super group	CCITT 312–552 KC
c. 600 channel grouping	CCITT 60–2540 KC
5. System compatibility	ATT standards—CCITT standards
6. Transmission facilities compatibility	Radio, wire and cable
7. Processing capabilities	Voice, digital data and graphics
8. Replacement for:	
a. AN/TCC-3	
b. AN/TCC-7	
c. AN/TCA-2	
d. Lenkurt 45A, 45BN and 45BX	
e. AT&T—J, K, L, M, & N	
f. ITT carrier systems	
g. Other commercial carrier equipment in AF inventory	
9. Signalling	In-band signalling with provision for removal to permit full channel bandwidth use for data transmission or other special purposes as required.
10. Common Equipment Load handling capacity	100% data loading with −5 db/channel loading
11. Voice channel characteristics	
a. Frequency Response	1 db maximum variation between 325 and 3450 CPS
b. Envelope Phase Delay	165 μsec 600–3200 CPS 100 μsec 1000–2500 CPS
c. Noise	
(1) Idle condition	15 dba or better, F1A weighting
(2) Loaded condition	23 dba or better, F1A weighting
d. Harmonic distortion	40 db below 0 dbm test tone at zero level. 1% harmonic distortion with 0 db input power at zero level
e. Nominal operating level	
(1) 2-wire operation	0 dbm input, 0 dbm output −16
(2) 4-wire operation	dbm input, +7 dbm output
f. Overload characteristics (Point at which relative reduction in gain versus power output at zero level is 1 db)	Approximately 8 db above test tone
g. Intermodulation distortion (f_1 and f_2 applied at 0 dbm at the zero point)	$2f_1$, $2f_2$ at 40 db below reference $f_1 + f_2$, $f_1 - f_2$ at 34 db below reference
12. Wideband capabilities (channel derivation capabilities)	(a) 60–108 KC (48 KC) (b) 312–552 (240 KC) Feature of basic configuration (c) Any other combination of 4 KC channels as desired, on special order
13. Power Requirements	
a. 60 channels	Approximately 200 watts
b. 600 channels	Approximately 750 watts
14. End To End Frequency Synchronization	Absolute

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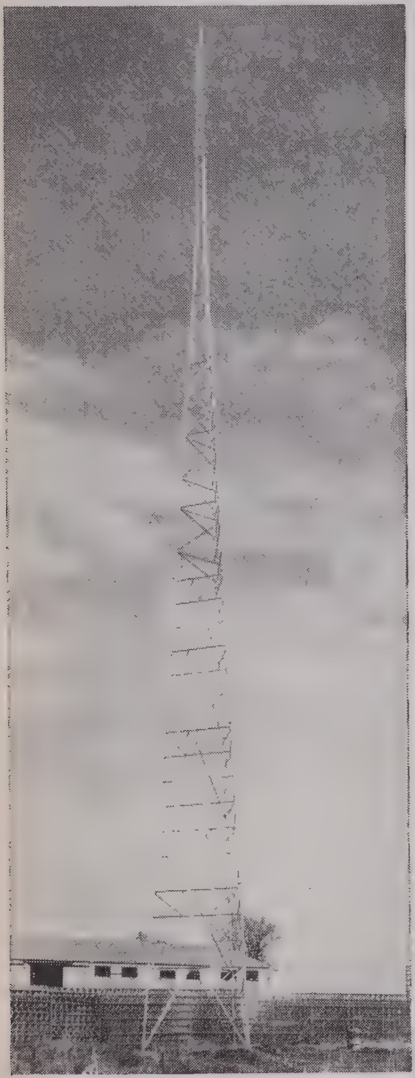
COMMUNICATION TOWER

NOW available up to 170 ft.!



- Fully self-supporting in heights up to 170 ft.
- Rated a true HEAVY-DUTY steel tower, suitable for communication purposes, such as radio, telephone, broadcasting, etc.
- Complete hot-dipped galvanizing after fabrication.
- Low in cost—does your job with BIG savings—yet has excellent construction and unexcelled design! Easily shipped and quickly installed.

FREE *details gladly sent on request. Representatives coast-to-coast.*

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"Pioneer Manufacturers of Towers of All Kinds"

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quencies will be within the group frequency allocation. The use of separate system pilots is not contemplated.

The idle channel noise of a back-to-back multiplex terminal will not exceed 15 dba (F 1 A Weighting) at the zero reference point on an idle system. The loaded per channel noise contribution of the multiplexer, due to intermodulation, harmonic distortion, etc., will not exceed 23 dba for 50% of the time as measured at the zero level point in an idle channel, with the remainder of the channels in the set fully loaded with voice, data, or any combination thereof.

Group and super group frequency

(*Continued on page* 224)

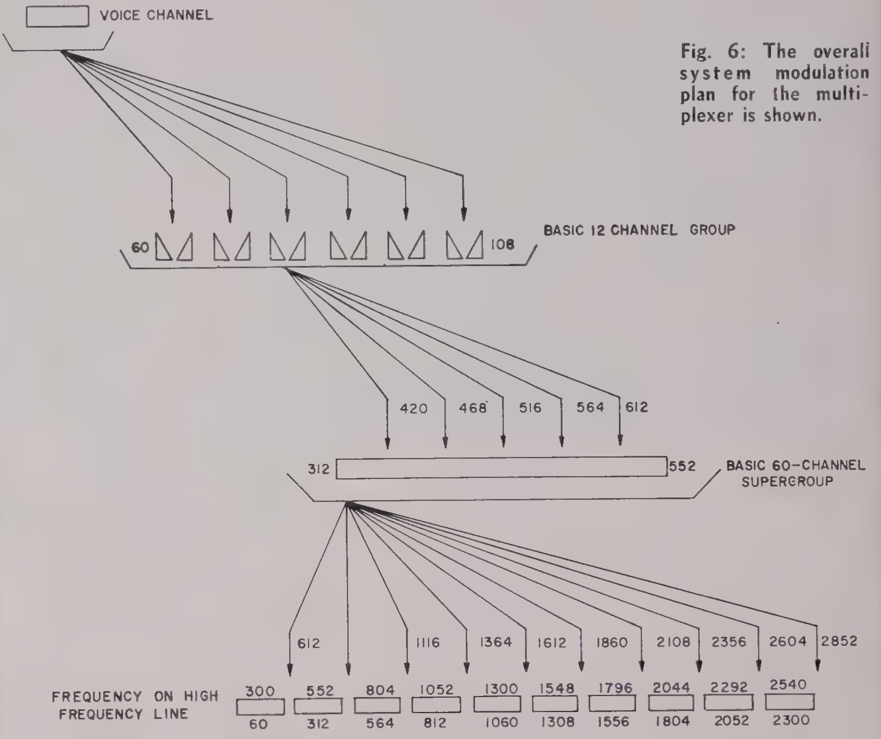

Fig. 6: The overall system modulation plan for the multiplexer is shown.

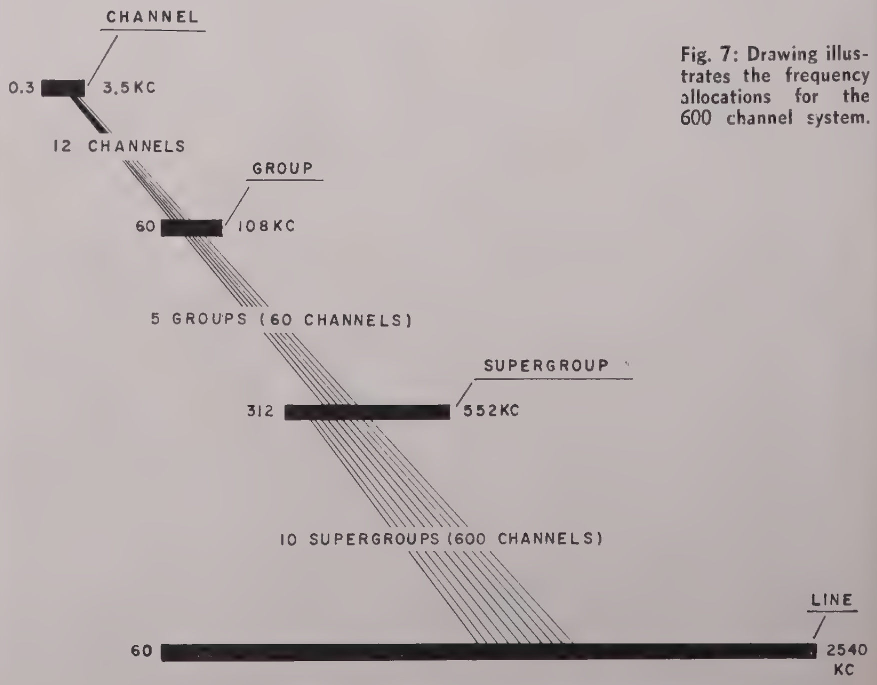

Fig. 7: Drawing illustrates the frequency allocations for the 600 channel system.

another Sarkes Tarzian production breakthrough!

Specifications at 25° C			
Tarzian Type	Zener Voltage (V)	Test Current (MA)	Dyn. Imp.(MAX) (Ohms)
VR6	6	25	4.0
VR7	7	25	5.0
VR8.5	8.5	25	6.0
VR10	10	12	8.0
VR12	12	12	10
VR14	14	12	11
VR18	18	12	17
VR20	20	4	20
VR24	24	4	28
VR28	28	4	42
VR33	33	4	50
VR39	39	4	70
VR47	47	4	98
VR56	56	4	140
VR67	67	2	200
VR80	80	2	280
VR90	90	1	340
VR105	105	1	400

Tarzian Silicon Voltage Regulators now at workday prices

1-watt

Epoxy enclosed

6 to 105 volts, in 20% increments

Standard tolerance is 20%
(all common tolerances available on request)

Immediate availability

Sarkes Tarzian did it in 1957 for silicon rectifiers and has done it again in 1961 for silicon voltage regulators...devised production methods that make it possible to offer quality silicon semiconductor devices at a price level that permits their use not only in Sunday circuits but also in workday circuits.

At the new low prices, more circuits can be better protected or improved in performance by the use of these small and inherently rugged devices as clippers, limiters, and regulators.

Send for price and ordering information.

Where highest quality is in volume production

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SEMICONDUCTOR DIVISION • BLOOMINGTON, INDIANA

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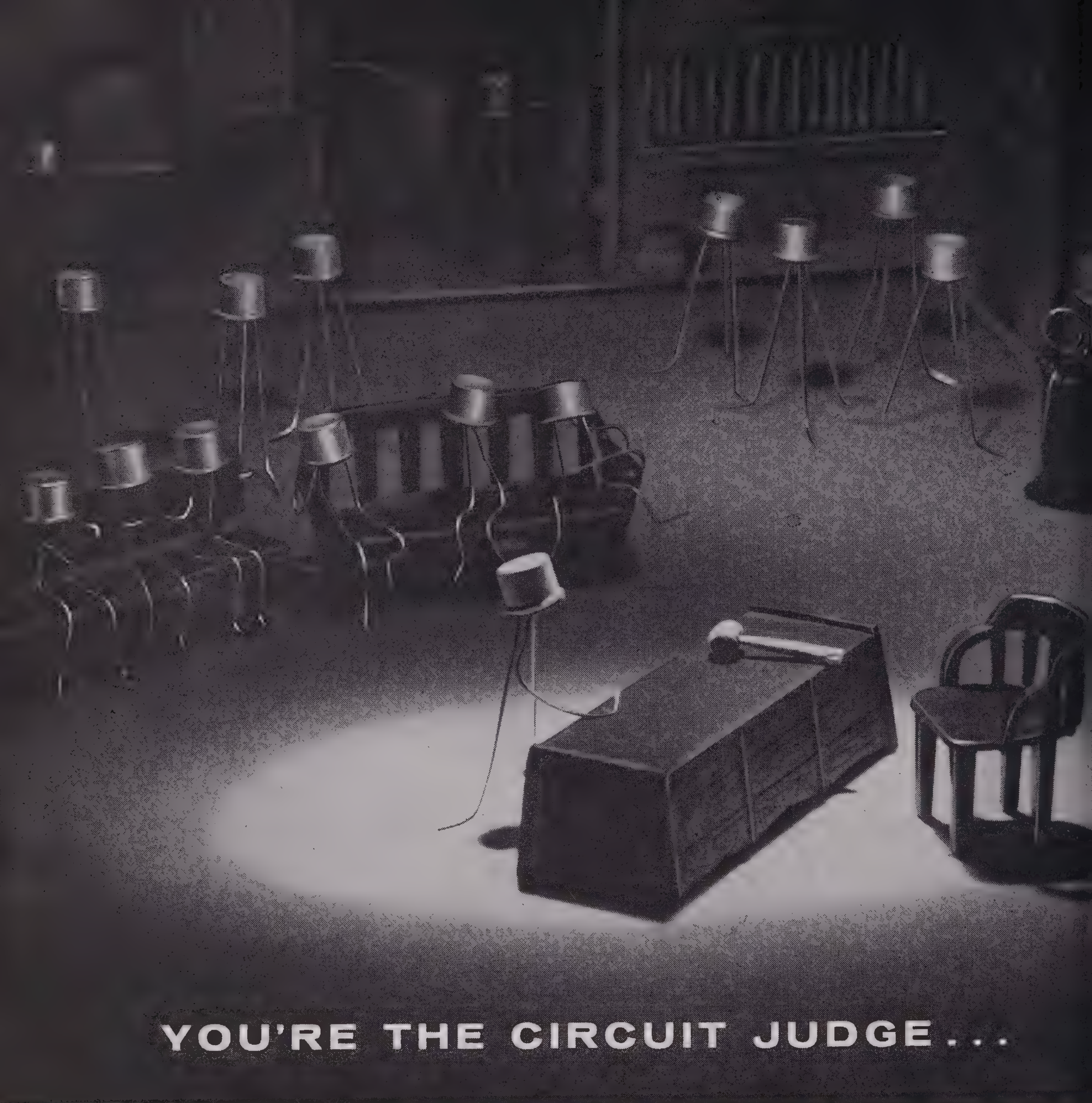

SPERRY

SPERRY SEMICONDUCTOR
DIVISION

OF
SPERRY RAND CORPORATION
NORWALK, CONNECTICUT

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...and it's up to us to present the facts.

Here's evidence on Sperry's PNP alloy junction silicon transistors:

1. All units are baked at 200°C for 200 hours and each device is doubly tested for perfect hermetic seal — through a 150°C hot oil check and a separate hydrostati test at 100 psi.
2. Sixty-three QC checks are performed before and during mechanized manufacture.
3. Our newly-built 65,000 square foot facility in Norwalk, Connecticut incorporates th latest techniques to produce the quality and quantity you require.
4. We offer you a wide variety of PNP types from which to choose.

May we have your verdict?

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AVAILABLE TO QUALIFIED ENGINEERS

*Trade Mark, Sperry Rand Corporati

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BURGESS has more than 5000 battery types to choose from:

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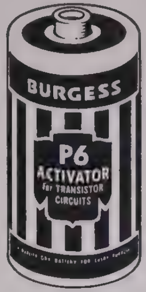
MERCURY
NICKEL-CADMIUM
WATER-ACTIVATED



each with the highest measure of uniform dependability! This is why 2 of 3 electronic engineers specify

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Most popular source of portable power, zinc-carbon batteries excel in adaptability, availability and economy. Burgess offers the widest range of choice in cylindrical and flat cells, plus exclusive patented "wafer-cell" construction for more compact power and uniform performance.

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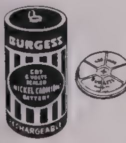
Burgess Quality-Controlled mercury batteries assure uniform operation over wide temperature range, high ampere-hour output, flat discharge curve. Long, non-fading service for instruments, transistor radios, portable electronic products.

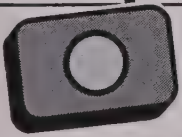


SEALED NICKEL-CADMIUM BATTERIES

A secondary rechargeable battery system which delivers high energy output from a small package! Hermetically sealed-in-steel cells eliminate maintenance and addition of liquids. Can be recharged many times, by trickle or quick charge, for long lasting economical power!

RESERVE BATTERIES

High energy output in a compact power source. Can be stored dry for years! Activated only when immersed in water. No handling of dangerous electrolyte, no spilling or leaking! Wide range of efficient operating temperatures. Designed for your specific applications.



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This construction offers compactness, long shelf life, exceptional service life. A 30% increase in battery life at no increase in size.

Check with your Burgess Distributor for complete local stocks of fresh BURGESS BATTERIES! Or your distributor can order from Burgess the special battery needed for your specific application!

FREE DESIGN SERVICE

For special applications, skilled Burgess Engineers offer you a FREE battery design service. Burgess will manufacture the exact battery to fit your needs, regardless of quantity required.

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New 100-page dry battery handbook now available! Engineers engaged in the design of battery-powered equipment are invited to write to Burgess Battery Company, Dept. ED, Freeport, Ill., to secure a copy. Others may buy the manual for $1.00.

BURGESS BATTERY COMPANY
Division of Servel, Inc.
FREEPORT, ILLINOIS

Circle 155 on Inquiry Card

Now NO-BLADE Stripping makes wire damage impossible!

New *IDEAL*

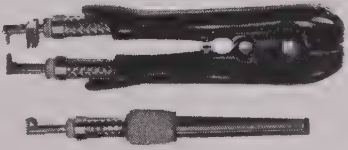
THERMO-STRIP

FOR PLASTIC INSULATION

- For use where absolutely no wire damage is permissible
- Can operate continuously—no warm-up delay
- Infinitely variable heat control—prolongs element life—reduces fumes

Especially designed to meet zero-defect requirements in assembly of missiles components, aircraft, computers and other precision electronic systems and instruments, the new Ideal Thermo-Strip Hot Wire Stripper completely eliminates the possibility of nicks, breaking or disturbing of strands in even the finest wires. *Not* just a converted soldering iron, it is all new, light-weight, easy-to-use, and safely removes all types of thermo-plastic insulation, including Teflon.

COMPLETE . . . READY TO USE . . . Includes 50-watt transformer and tool of your choice. (Shown with Pincer mounted for high-speed production stripping.)



PINCER
Just grip wire, twist, and pull off insulation slug with heating elements.

SINGLE LOOP
For "probing" into miniature or crowded assemblies. Just put wire end in V-notch of electrode.

Elements may be formed for any wire size or particular service.

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TOWER TIPS

COLD WEATHER AND TOWER STRENGTH

How does cold weather affect the strength of a steel tower? Good question! Sometimes it is written into a tower specification. Worry-warts and steel salesmen point out that "Charpy-Impact" values for mild carbon steel fall off rapidly with falling ambient temperature—(although yield does not). Therefore, you must buy and use high priced fancy steel alloys whose Charpy values do not fall off as fast as those for mild steel.

Let us think a moment. Let us look around. We know, for example, that there are literally thousands of mild carbon steel towers in service for dozens of years in both the Arctic and the Antarctic. They work! I guess they never heard of Charpy. Is not this an indicator of something?

Well, the worried physicist and engineer say: "yes, but our new requirements have more impact loads imposed upon our towers." Oh yeah? Let us assume they do. Define the new impact load. Would you say shooting a .45 bullet through the steel column constitutes an impact condition? Too severe a condition?

Several winters ago, we had the opportunity to modify a number of mild steel towers in Canada. A portion of the work constituted in making hundreds of holes in the steel columns. Electric hand drills, hundreds of feet in the air, in isolated locations, long leads, cold hands, did not appeal as an efficient way. We decided to try using a Ramset to shoot the holes. This tool uses an explosive cartridge which shoots a slug into the steel, and upon withdrawing the slug, you have a nice round hole. *It worked!* Hundreds of holes! And the temperature was never above *20 below zero* (°F). Would you say that was a mild impact test?

There is nothing wrong with Charpy impact tests. But, do not misuse them. Or, how do you correlate Charpy Impact numbers with actual working conditions? High nickel steel alloys, high Charpy numbers, are all good and wonderful. But—do we need them?

For my buck, I will use mild carbon steel to build towers anywhere on this old globe—and sleep well.

Walter L. Guzewicz

Stainless, inc.

NORTH WALES • PENNSYLVANIA

CUES for Broadcasters

Modifying the Video Transmission Test Set

STEPHEN J. STANLEY, Studio Supervisor
WAST TV, Albany, N. Y.

WAST has, along with other test gear, a Telechrome Video Transmission Test Signal Unit, Model 1005-A1. Those familiar with this instrument know that it is capable of generating composite test signals as follows:

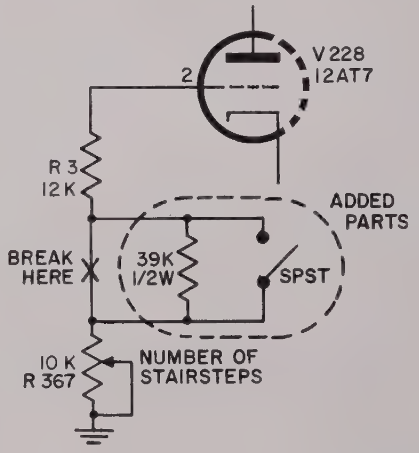
1. Multiburst.
2. Stairstep.
3. Stairstep with 3.58 MC.
4. Window.

The stairstep is, of course, used for linearity measurements and is usually adjusted to present 10 steps of equal amplitude from black to peak white.

Here we show a modification that can be made to this signal. This modification proved workable in light of a service bulletin, G102-2, from Ampex. This bulletin introduces a new procedure in the method of optimization of record currents in the video head.

In this procedure a "doorstep" signal is required. The "doorstep" signal is defined as a three level video signal, plus standard sync. Each level occupies approximately one-third of the active horizontal line period, with black at 7.5 IRE units, Grey at 53 IRE units, and white at 100 IRE units.

The "stairstep" signal in the Telechrome unit may be changed to "doorstep" by the following modification:



Step 1. Drill and punch ½ in. hole for toggle switch between T201 and F201 just below R367 "Number of stairsteps adjust."

Step 2. Mount, but do not solder, ½ watt resistor (39K) across terminals of switch and mount switch in hole made in step 1.

Step 3. Remove the end of R366, 12K resistor, from #1 terminal of R367, 10K pot "Number of stairsteps" control. Using a short jumper solder this end of resistor to one terminal of new switch.

Step 4. Using short jumper, connect other end of switch to #1 terminal of R367 just vacated by one end of R366. This completes modification.

"Doorstep" signal is now adjusted by R367 for stability and stairstep setup and master level controls are adjusted for proper amplitudes of black, grey, and white.

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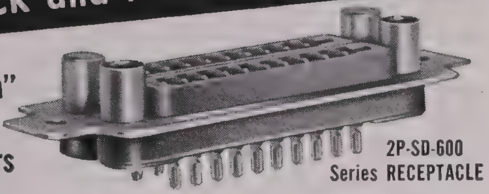
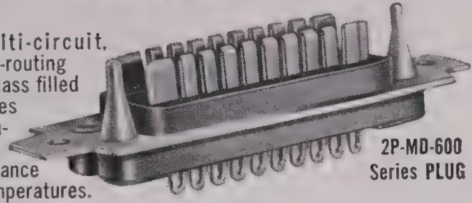
CONNECTORS

For RACK and PANEL Applications


"Reli-Acon" Paired Connectors

2P-SD-600 Series RECEPTACLE

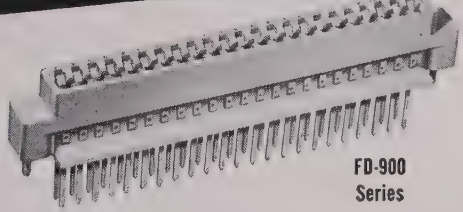

2P-MD-600 Series PLUG

Ideal for multi-circuit, switching or re-routing applications. Glass filled "DIALL" provides excellent dimensional stability and high resistance at elevated temperatures.

Female contacts designed to provide low millivolt drop after repeated insertions and assure positive contact under extreme vibration. Contacts are of spring tempered phosphor bronze, gold-plated which will not tarnish or corrode and provide good solderability for an indefinite period.

Mounting plates are cadmium plated steel to meet the most extreme environmental conditions. Optional floating mounting grommets allow for misalignment during mating. Polarizing pins provide positive mating.

For WIRE WRAP APPLICATIONS


"Reli-Acon" Card Receptacle

FD-900 Series

These printed circuit card receptacles meet most rigid requirements of military applications. Can be used with single or double-sided printed circuit boards. Contact terminals of the preferred wire wrap type spaced on .200 grid centers provide rapid, dependable mechanical connections through use of individual wrapping gun or programmed automatic wiring.

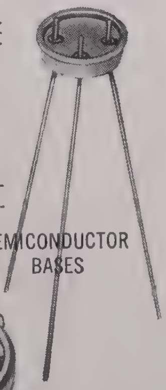
HERMETIC SEALS

By Thermo-Ceram, subsidiary

Available in individual bead or complete insert bead. Our complete custom hermetic seal connector facilities include:

- production of excellent glass to metal seals
- designing to meet your hermetic seal requirements
- engineering assistance and guidance

Products include: semiconductor bases, relay headers, single seals, feed through terminals, connectors, switch cover assemblies.


SEMICONDUCTOR BASES

RELAY HEADERS

Illustrated literature and technical data are available upon request. We invite your inquiry.

Methode Electronics, Inc.

7447 West Wilson Avenue
Chicago 31, Illinois

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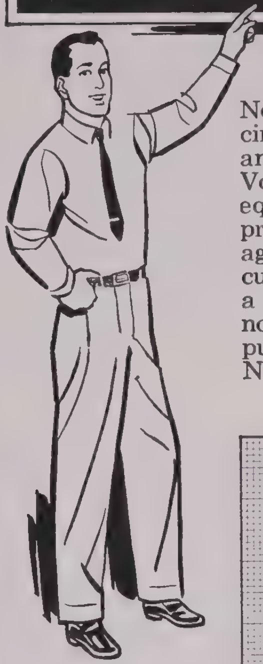
Acme Electric

CONSTANT VOLTAGE STABILIZERS PROTECT THEMSELVES AGAINST OVERLOAD!



No need to "fuse" the output circuit against overload when an Acme Electric Constant Voltage Stabilizer is part of the equipment. These stabilizers provide automatic protection against overload or short circuit. When load current reaches a critical point in excess of normal operating load, the output voltage is reduced to zero. No voltage — no current.

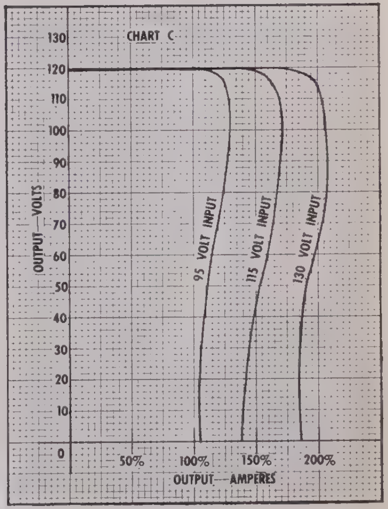
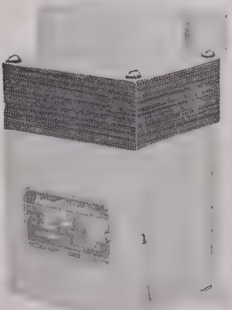


Chart shows performance curves under various voltage inputs and current overload conditions. This current limiting is accomplished automatically.



If you have ever observed the "quickness" of two cycles, 1/30 second, then you'll appreciate the speed with which these stabilizers respond to a fluctuation in line voltage.

Available in sizes from 15 to 2000 VA. Input voltage ranges 95/130, 190/260. Output voltages stabilized at 6.3, 120, 240 volts. *Write for catalog 09-B01.*

ACME ELECTRIC CORPORATION
898 Water St. Cuba, N.Y.
In Canada: Acme Electric Corp. Ltd., 50 Northline Rd., Toronto, Ont.

SAA3515/1967

Acme Electric

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Dielectric Constants *(Concluded)*

the tangent of this second assumed Q. Then the test to see if C is equal to the original value of C is repeated. If they are equal, then the machine should be instructed to use the value of Q corresponding to this value of C, and the routine is complete. If they are not equal, then a third approximation to tan $(Q)/Q$ is made by taking the arctangent of the original value of C times the second value of Q. With this third approximation to tan $(Q)/Q$ a new value of C is found by taking the tangent of this third assumed Q. The test is made again and the routine repeated if necessary. A sample routine, Program 1, can easily be modified to include values of Q less than one. "R" is the particular multiple of π necessary to put Q into the proper quadrant. Provisions must be made to jump out of the loop when the test at instruction 3 shows that $C^n = C$ within the accuracy desired.

It is possible to obtain accuracy as high as the computer limit depending on the portion of the curve on which you are operating. At the extremes, accuracy is dependent on the accuracy of the subroutine used for computing tan Q. Usually this is at least three places behind the decimal point.

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of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

Major Program

The major program for computing the dielectric constant and loss tangent is straightforward Program 2. The input instructions (the instructions that feed the parameters into the machine) and the output instructions (the instructions that print the results) have been left out for obvious reasons. This program was written in Fortran and this method of direct programming has its own bookkeeping methods for inputs and outputs.

In Step 3, we use the general formula for wavelength, i.e., the speed of light divided by the frequency. In Step 4, a = longest cross sectional edge of the waveguide. The C of Step 5 is used in the subroutine which computes Q.

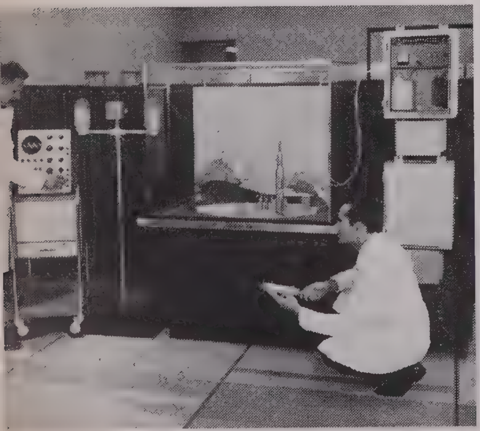
Now, the machine has the necessary parameters to compute the dielectric constant, electrical thickness and the uncorrected value of the loss tangent. An instruction may be written to compute the loss factor, caused by the walls of the waveguide, and inserted in the program so a corrected value of the loss tangent can be computed; or, a value of the loss factor may be inserted, as a parameter, each time. The latter method is preferable because over a period of several days or weeks, depending on usage, the loss factor is relatively constant, in addition, computer time is conserved.

References

1. Von Hippel A. *Dielectric Materials and Applications,* MIT Press and John Wiley & Sons, Inc., New York.
2. Montgomery, *Technique of Microwave Measurements,* MIT Radiation Laboratory Series, Vol. 11.
3. Carpe, Bernard, "Instrumentation for the Determination of Phase Delay in a Radome Wall"; WADC Tech. Rpt. (AF 33-(616)3092).
4. ATC Rpt. No. ARTC-4, "Electrical Test Procedures for Radomes and Radome Materials," Aircraft Industries Assoc.
5. Roberts, S. and Von Hippel, A. "A New Method of Measuring Dielectric Constant and Loss in the Range of Centimeter Waves," *J. of Applied Physics,* Vol. 17, July, 1946.
6. Gray, B. C. "Measurement of Dielectric Constant and Dissipation Factors at Microwave Frequencies," *Electronic Industries,* Vol. 19 No. 11, Nov. 1960.

Gas Detector

A NEW electronic instrument detects trace quantities of toxic and explosive gases in the atmosphere. The instrument, termed the Olfactron because it is essentially an electronic nose (Latin Olfacere, to smell) is produced by American Systems, Inc., Hawthorne, Calif.



Gas injected into test chamber is detected by Olfactron and displayed on instrument panel meter. Gas level buildup, which triggers alarm system when maximum acceptable concentration (MAC) is reached, is displayed also as oscilloscope waveform pattern.

In a dramatic display of the equipment's actual operating capabilities, scientists injected minute quantities of the highly toxic rocket fuel UDMH (unsymmetrical dimethyl hydrazine) into a sealed, transparent chamber. A UDMH Olfactron was installed beside the chamber with a CRO connected that showed the buildup of gas concentration within the chamber. As gas entered the chamber the needle moved in proportion to the level of vapor present. At the point when the concentration, expressed in parts-per-million of vapor, equaled a preset level, the instrument signaled a warning; a horn and flashing light.

The basic electrochemical principle of the Olfactron is that the vapor sensed produces a proportional electric current, which in turn can be indicated on a meter, or recorded. Because they are quick reacting, continuous measuring devices, they can readily be incorporated into electronic warning systems. The instruments are designed for use at missile installations, and at other locations where propellants are manufactured, tested, transported, or stored. Two such instruments have recently passed extensive field tests at a rocket engine test site.

The physical detection principle of the Olfactron is also being applied to the monitoring of trace quantities of many other gases and vapors having critical toxic, explosive, or odorous properties.

WHY YOU SHOULD THINK OF

MAPICO

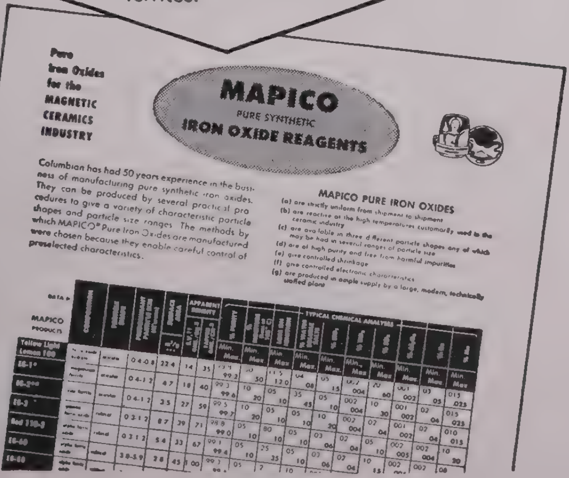
WHEN YOU THINK OF IRON OXIDES FOR FERRITES!...

First of all, Mapico provides a wide range of pure synthetic iron oxides . . . unmatched for uniformity . . . produced through the most precise automatic production controls . . . in a plant with tremendous capacity. And Mapico iron oxides are made in three typically different particle shapes, each shape available in many accurately graded particle sizes. The selection of the proper Mapico oxide assists you in controlling electronic characteristics and shrinkage.

MAPICO IRON OXIDES UNIT

COLUMBIAN CARBON COMPANY
380 Madison Ave., New York 17, N.Y.

WRITE FOR
this useful, free, informative chart on MAPICO pure synthetic iron oxides for ferrites.



Pure Iron Oxides for the MAGNETIC CERAMICS INDUSTRY

MAPICO
PURE SYNTHETIC
IRON OXIDE REAGENTS

Columbian has had 50 years experience in the business of manufacturing pure synthetic iron oxides. They can be produced by several practical procedures to give a variety of characteristic particle shapes and particle size ranges. The methods by which MAPICO® Pure Iron Oxides are manufactured were chosen because they enable careful control of preselected characteristics.

MAPICO PURE IRON OXIDES
(a) are strictly uniform from shipment to shipment
(b) are reactive at the high temperatures customarily used in the ceramic industry
(c) are available in three different particle shapes any of which may be had in several ranges of particle size
(d) are of high purity and free from harmful impurities
(e) give controlled shrinkage
(f) give controlled electronic characteristics
(g) are produced in ample supply by a large, modern, technically staffed plant

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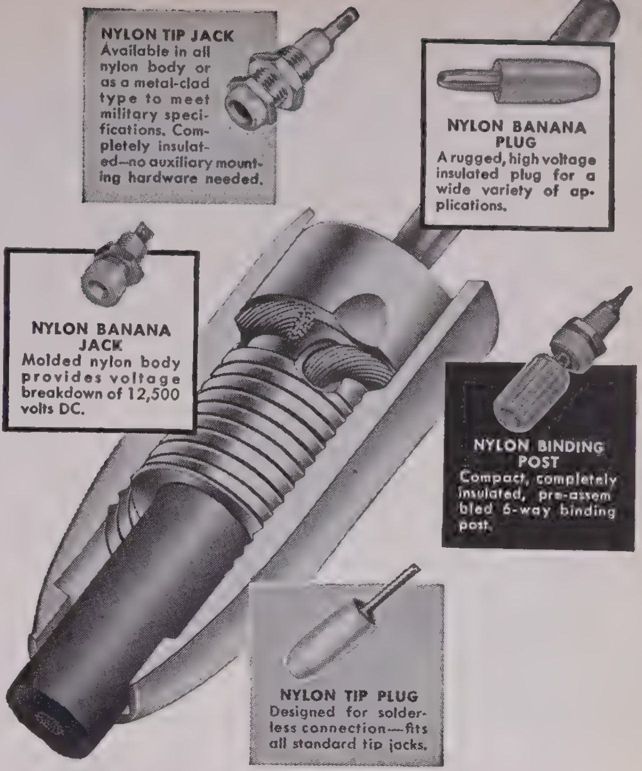


NYLON TIP JACK
Available in all nylon body or as a metal-clad type to meet military specifications. Completely insulated—no auxiliary mounting hardware needed.

NYLON BANANA PLUG
A rugged, high voltage insulated plug for a wide variety of applications.

NYLON BANANA JACK
Molded nylon body provides voltage breakdown of 12,500 volts DC.

NYLON BINDING POST
Compact, completely insulated, pre-assembled 6-way binding post.

NYLON TIP PLUG
Designed for solderless connection—fits all standard tip jacks.

NYLON CONNECTORS

Voltage breakdowns up to 12,500 volts DC!

These rugged Johnson connectors are molded of tough, low-loss shockproof nylon—and will not chip or crack, even when subjected to extreme temperature changes or severe mechanical stress. Nylon provides high voltage insulation, with voltage breakdowns up to 12,500 volts DC. Metal clad tip jack meets MIL specifications (full specifications available on request). All connectors are designed for fast, easy mounting—and are available in 13 bright colors for coded applications.

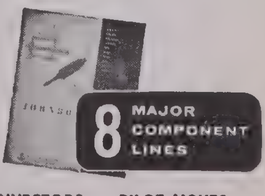
OTHER CONNECTORS—Johnson also manufactures a complete line of standard connectors in addition to the nylon line described above. For complete information, write for our newest components catalog shown below.

NEW

DUAL BANANA PLUG
Extremely versatile—provides variety of application possibilities. Solderless design—tough shock resistant nylon body retains strength and low-loss characteristics over a wide range of temperature and high relative humidity conditions. Available in 13 permanent colors.

New Catalog

Write today for our newest electronic components catalog—complete specifications, engineering prints and current prices on:



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- INSULATORS • KNOBS, DIALS • INDUCTORS • HARDWARE

E. F. JOHNSON CO.
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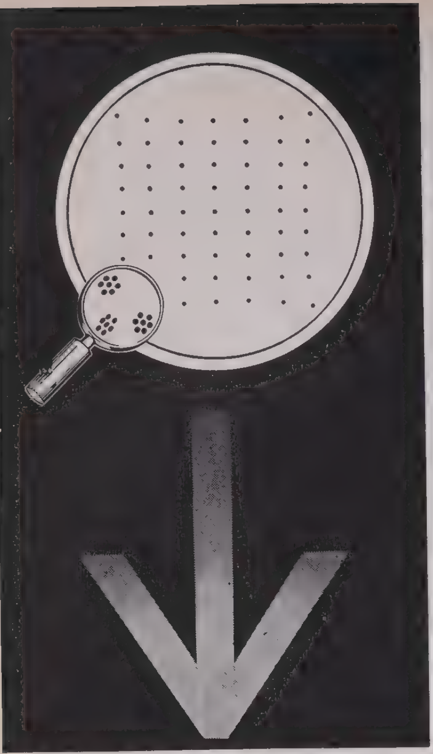
Circle 160 on Inquiry Card



WHY

MAJOR C. R. TUBE MFGRS.
RECOMMEND
SYNTRONIC YOKES

Exceptional manufacturing uniformity. Achieved by unique pepperpot tube testing—the most comprehensive method known for precise measurement for spot uniformity . . . to attain extremely accurate focusing. For technical details, request ELECTRONIC INDUSTRIES reprint #6-57 from Syntronic Instruments, Inc.

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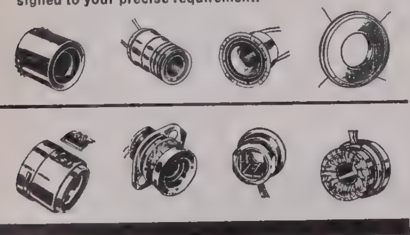
The Industry's broadest yoke line . . . already tooled for quantity production. Or, yokes can be custom designed to your precise requirement.



Circle 161 on Inquiry Card

Multiplexer

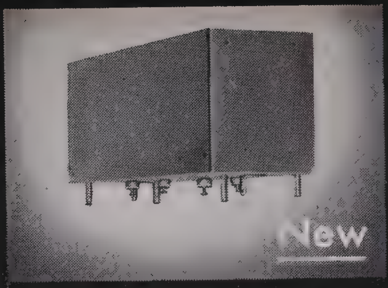
(*Continued from page* 216)

allocations are in conformity with CCITT standards. Sideband allocations will be in accordance with CCITT standards for grouping and super grouping only. The channel modulation plan differs from the CCITT recommendations in that twin channel modulation will be employed. The twin channel plan offers several advantages over the CCITT standards, such as reduced requirements on the channel low pass filters, and reduction of the number of carriers to a total of six.

The use of in-band signalling is planned which will be a separate entity from the basic equipment. This particular feature is desirable from an Air Force standpoint since it not only permits the use of the entire channel bandwidth for data transmission, or some other purpose, but more important, does not preclude combining a number of channels for special wide band uses. Although the Air Force has certain preferred signalling permutations and has made recommendations along these lines, it is not known at this time what precise form this will take. Since the signalling concept is singularly dependent upon the form of the switching complex, a final decision on its composition must await approval of the switching plan. We anticipate no insurmountable problems in this regard.

Equipment Flexibility

It was mentioned above that combinations of channels for special applications is a distinct possibility. A basic element of the design philosophy of this multiplexer is flexibility. The strength of this factor seals the fate of the piece of machinery of this type early in life. Buried deep in the word "universal" as used here is the connotation that flexibility is achieved which allows the employment of this system for any reasonable multiplexing task. The Air Force now has, and will continue to have, requirements for long distance transmission of both digital and analog information of band-



BULOVA
S S BAND
CRYSTAL
FILTERS

With the ever increasing demand for Single Side Band Communication Systems for High Frequency Voice communications, fascimile and multi-channel frequency shift keying teletype operation, Bulova Electronics added Model 283 Single Side Band filter to their standard line of crystal filters.

Designed to surpass the Signal Corps SM-D-180214 and SM-D-180215 Single Side Band Filter Specifications, the new Bulova Model 283 features an unusually flat passband, low insertion loss and operation over a large temperature range.

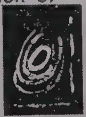
General Specifications include:
Carrier Frequency—100kc;
Carrier Attenuation—13 db;
Maximum Ripple—±0.5 db;
Insertion Loss—less than 5.0 db;
Input Output Impedance—1.5 k Ω balanced or unbalanced;
Operating Temperature Range—−40°C to +70°C.

Type 10WL Lower Side Band—Model 283 features Passband—±0.5 db from 94kc to 99.875kc and Minimum 60 db Attenuation at 100.2kc and above.

Type 10WU Upper Side Band—Model 283 features Passband ±0.5 db from 100.125kc to 106kc. Minimum 60 db Attenuation at 99.8kc and below.

The new Bulova Model 283 can be driven from a balanced or unbalanced source and its low input and output impedance make it readily adaptable to transistor circuitivity.

For additional information or application assistance, write Department 2155, Bulova Electronics, Woodside 77, N.Y.



BULOVA
ELECTRONICS
DIVISION

Circle 162 on Inquiry Card

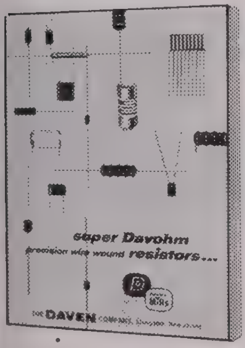
widths greater than the nominal 4 KCS. Television is but one of these. To meet this need and to preclude obsolescence of this multiplexer before its use, we are developing means of combining 2, 4, 8, 12, 16 and 24 nominal 4 KCS channels, to provide one continuous wide band channel for special applications.

Unitized and modular concepts are being used to provide maximum flexibility of use and ease of upgrading the fundamental equipment as the state of the art so dictates. "Receive and transmit" terminals are separate physical units which facilitate flexible plant configuration and permit economical implementation of simplex channels where required.

The entire complex will be transistorized, and maximum use will be made of printed circuits. In the interest of simplified maintenance, maximum use will be made of self-contained test equipment and automatic fault locators.

The self-contained test equipment will provide normalized meter readings of all adjustable circuit levels. Any circuit malfunction will be indicated by an abnormal reading which cannot be corrected by an adjustment.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.



ALL ABOUT RESISTORS!

Daven's new 20-page precision wire wound resistor catalog is the most comprehensive publication of its type. It's chock full of technical data, performance curves, photographs, applications, military specs — everything you'll need to know about Davohm and Super Davohm resistors, miniature, sub-miniature, axial lead, lug, printed circuit, high frequency, card, ceramic, and hermetically sealed types, as well as complex networks. All this . . . PLUS new information about ultra-stable high-reliability units. **Write today for your free copy!**

THE **DAVEN** COMPANY
A SUBSIDIARY OF GENERAL MILLS
General Mills
RESISTORS Livingston, New Jersey
TODAY, MORE THAN EVER, THE DAVEN Ⓓ STANDS FOR DEPENDABILITY

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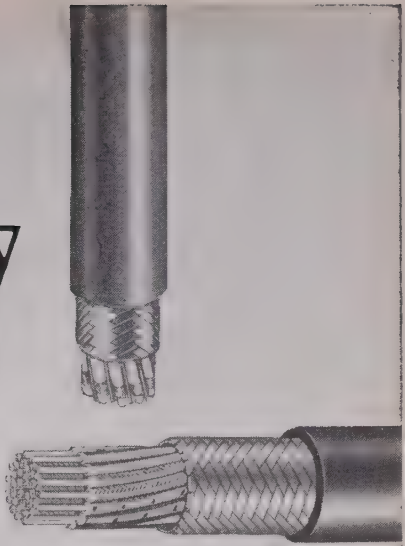

TIMES

High and Medium Temperature MULTI-CONDUCTOR CABLE

For Critical Applications

TIMES' experience in designing and manufacturing R.F. coaxial cable, data transmission cable, and low frequency control cable adds up to multi-conductor versatility to solve *your* problems.

As a "one source" manufacturer of all multi-conductor cable components, TIMES can produce round and ribbon cables utilizing almost infinite combinations of coaxial cable, Teflon®, PVC and polyethylene hook-up wire, and low capacitance cable.

Choose from TIMES *standard* engineered multi-conductor cables, or let our Engineering Service assist you in designing cables and *cable assemblies* to meet your specific requirements. ® DuPont

TIMES WIRE & CABLE DIVISION
The International Silver Company
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Clip This Coupon To Your Calling Card or Letterhead

Please rush FREE literature on:
☐ Coaxial Cables
☐ Data Transmission Cables
☐ Multi-Conductors & Hook-up Wire
☐ For Info Only ☐ Have Rep. Call

Circle 164 on Inquiry Card

In September 1959, "Hurricane Hunters" of the U. S. Navy kept a 24-hour vigil on Hurricane Gracie. They took 30,000 frames of pictures in and around this severe storm — kept the Joint Hurricane Warning Center constantly alerted to Gracie's feminine eccentricities. As a result of this dangerous death watch, only 22 deaths were attributed to Gracie and property damage was minimal.

Soon the romantic "Hurricane Hunters" will be phased out — their observations superseded by highly advanced electronic equipment. Similar changes will be made in other areas as the national weather services utilize the latest technology (including weather satellites) to improve all aspects of weather observation and forecasting.

To speed these changes the Weather System Center is assisting in the development of a host of new techniques and electronic equipment for weather observation, data transmission, data processing and display. Experimental weather systems will be operated to test out these techniques and equipment; a high-speed communication system developed.

Because of major expansions in this project, the Weather System Center now has a number of very attractive openings for ELECTRICAL ENGINEERS at both supervisory and operational levels. All of these positions offer unusual challenge and the opportunity to build a satisfying career in a field with outstanding growth potential.

★ ★ ★

SUPERVISORY POSITIONS for: Engineering Supervisor • Senior Test Engineer • Station Engineer • Staff Test Engineer • Data Transmission Specialist.

★ ★ ★

Other opportunities for: Radar Engineer • Display Engineer • Computation Analyst • System Analyst • System Engineer • Digital Communication Equipment Engineer • Weather Observing Equipment Engineer • Meteorological Analyst • Technical Editor • Technical Writer • Electronic Technician.

★ ★ ★

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

★ ★ ★

Please write to Mr. F. M. Finch, Personnel Department.

UAC WEATHER
SYSTEM CENTER
UNITED AIRCRAFT CORPORATION / 400 MAIN STREET, EAST HARTFORD 8, CONN.

Circle 801 on "Opportunities" Inquiry Card

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers

MIT Professor Awarded 1961 AIEE Lamme Medal

The American Institute of Electrical Engineers have announced the award of the Lamme Gold Medal to Dr. John G. Trump of Massachusetts Institute of Technology, Cambridge, Mass. Dr. Trump is widely known for his design of high voltage X-Ray and electron sources used in medical research and in the treatment of malignant diseases.

The Lamme Medal was established through a bequest of the late Benjamin G. Lamme, chief engineer of the Westinghouse Electric and Manufacturing Co., now Westinghouse Electric Co. It is to be awarded to a member of AIEE "who has shown meritorious achievement in the development of electrical apparatus or machinery."

National Science Foundation Survey

A survey conducted for the National Science Foundation by the Department of Health, Education, and Welfare, Office of Education, revealed that 44% of the scientists and engineers at U. S. colleges and universities during 1958 were engaged in research and development.

By field of science, the scientists and engineers were employed as follows: in the life sciences, 47%; physical sciences, 26%; engineering sciences, 17%; and social sciences, 10%.

These findings of a survey on the expenditures and manpower resources in research and development in colleges and universities for the year 1958 are announced in "Reviews of Data on R & D, No. 27, Scientists and Engineers Engaged in R & D in Colleges and Universities in 1958." Copies may be obtained from the Supt. of Documents, U. S. Govt. Printing Office, Wash. 25, D. C., for 10 cents.

Nation Producing Only About Half the Scientists it Needs-Warns Dr. Wiesner

The nation is producing only about half the top-level scientists it needs, Dr. Jerome B. Wiesner, President Kennedy's special assistant for science and technology, said in accepting the 1961 Medal of Honor of the Electronic Industries Association.

Dr. Wiesner said the country needs between 12,000 and 15,000 scientists yearly in contrast with the present output of about 6,000. He estimated that the national demand for engineers and scientists would total between 2 and 2½ million in 1970. He said that the threatened national manpower shortage confronts industry with a clear challenge to use technical help more efficiently.

Dr. Wiesner was awarded the EIA medal for "distinguished service contributing to the advancement of the electronics industry." He was the first government official so honored since the award was established in 1952. EIA President L. B. Davis, who made the presentation, described Dr. Wiesner's White House appointment as "recognition at the highest level of his outstanding talents and ability as a scientist who knows how to get things done."

Dr. Wiesner called the electronics industry "the backbone of the technology which supports our nation" and a "mainstay" of its civilian economy. He called attention to concern "all over the country" with the present rate of industrial development and said the nation looks to the electronics industry to set the pace for improvement.

Silver Anniversary For EIA Treasurer

EIA president L. B. Davis presents silver service in recognition of 25 years as EIA treasurer, to L. F. Muter (right), of the Muter Co. Mr. Muter was reelected a 26th time.

Training Schools

The Ohmart Corp., Cincinnati, Ohio, has inaugurated a series of training schools in engineering and installation fundamentals of their nuclear density, thickness, and level measuring systems. They will be conducted on a periodic basis for both Ohmart representatives and other interested technical personnel. Engineers interested in attending one of the schools should write to H. L. Cook, Jr., vice-president in charge of engineering, The Ohmart Corp., 2236 Bogen St., Cincinnati 22, Ohio, for further information.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 189.

Wins Award

Dr. Lester M. Field, Manager of Hughes Aircraft Co.'s Microwave Tube Div., has received an award for the best presentation at the Winter Convention on Military Electronics. His paper was on developing wide-band, high power, traveling wave tubes capable of producing several kw continuous wave and up to several hundred kw pulsed.

The tendency, when hiring personnel, is to take them at "face value." In terms of hiring and training costs, this can be a costly method when, later, they are found undesirable.
In most cases, pre-employment investigations can eliminate these mistakes at a substantial saving in time and money.

Investigate Before Hiring

By C. V. D. ROUSSEAU*
Exec. Vice-Pres.
Fidelifax, Inc.
New York, N. Y.

MANY of the persons hired today for responsible positions have one or more bad traits. These traits would have caused rejection had the employer been aware of them. Some of these traits are emotional instability, chronic absenteeism, dishonesty, alcoholism, and just plain poor work.

How could this happen with such modern hiring practices as psychological and job performance tests, special interviewing techniques, et al? All of these techniques tell us only one thing: the applicant's possibilities. These things do not tell us how he actually will perform.

One of the best methods of determining how a prospective employee will act is to learn how he acted in the past. But this is not as easy as it sounds. Because of the award or cancellation of huge government contracts in various sections of the country—and because of ease of transportation—much of the nation's work force is becoming semi-nomadic.

So how do we learn how an applicant has performed? Written or telephonic requests are generally of minimal value because of delay in replying, the desire of a past employer to give the man he fired "a break," fear of lawsuits, etc. The ideal method, of course, is the personal interview of former employers, co-workers, neighbors and others. However, this is a financial impossibility for all but the largest corporations, with the facts scattered in time and geography throughout the background of the applicant.

Hire and Hope

Too many employers all but give up and adopt a "hire and hope" policy. But what employers are too prone to forget is that one "bad apple" in the company "barrel" can start a chain reaction of spoilage that can have disastrous effects.

Manufacturers may check an accountant or technician before hiring. However, when it comes to an engineer, usually no. They are afraid someone else may "grab" him while they are checking. Actually, many engineers are secretly pleased when they find out they have been checked professionally and personally. This indicates that their fellow employees are required to meet the same standards, hence they are good.

If a man is hired who is lazy or lackadaisical, how much time, at what wages, has he wasted? If he is incompetent, what is the cost of poor work? How much production can he hold up?

This is only part of the story. Equally important is the fact that, with our entrance into the space age, jobs are more demanding and complex, and therefore it is taking longer to "try out" an employee. In many industries, the current probationary period is not long enough to adequately check a man's skills and abilities.

The cost of mistakes in hiring today can reach almost astronomical proportions. But these mistakes can be avoided by interviewing a prospective employee's former supervisor and co-workers. There are several national firms that will do it for you. It is called "personal pre-employment investigation"—PEI for short.

What Investigating Does

The objective of PEI is not simply to seek out the proverbial skeletons-in-the-closet concerning applicants. Rather, it helps the personnel department obtain detailed, factual information on applicants' backgrounds and how well they will fit into the company and get along with those they must work with.

---

*Mr. Rousseau is also president of Fidelifax Southwest, Phoenix, Ariz.

Facts are not assessed by the investigator, but passed to the personnel executive who is then in a far better position to analyze how capably and energetically the applicant has lived up to his work potential as determined by interview and testing. In short, expert, pre-employment investigation establishes the applicant's real behavior pattern.

A considerable percentage of all investigations undertaken by companies like Fidelifax is in the field of security clearance. Even though the government is responsible for the security clearance of all persons who will be working on Secret or Top Secret defense projects, the employer often finds himself behind the financial 8-ball if he neglects to make preliminary checks himself. Because of the exigencies of today's defense contracts, many an employer has been forced to hire a man and wait for his security clearance. Meanwhile, he must train and possibly outfit him and provide him with all the fringe benefits — health insurance, pensions, etc.—that are so much a part of the economy today, before he is even permitted to see classified material. Four months later he may be chagrined to learn, from the government, that the man is not acceptable. Out he goes, but who is really "out"?

It is also the employer's obligation to provide a "company confidential" security clearance for all others who will work in the same plant as—but not have access to—Secret or Top Secret projects. Such Company Confidential Classification can be assigned only after the employee's background has been thoroughly investigated.

For a company confronted with a chance to bid on a profitable government contract, this factor of security more than once has literally meant the difference between success or failure. If a company which has not undertaken secret government work should suddenly be awarded a contract in this field, every employee must then be cleared. And the fact that an employee has never been a member of the Communist party is not prima facie evidence of his purity. For example, a poor credit risk can be a poor security risk, according to the government. The man Khrushchev would first try to hire to crib the company secrets is that "personality (problem) kid," the desperate status seeker the bill collectors are always hounding. If a high percentage of employees won't pass inspection, and if the firm is located where labor is in critically short supply, this leaves the company with a rugged recruitment problem, particularly where professional and supervisory personnel are concerned. This also leaves the company with the problem of what to do with those employees who are not cleared. Discharge them? Better check your conscience first. If, on the other hand, all employees are well checked before they are hired, it is likely most all will be cleared.

Causes of Turnover

The following causes of turnover, focusing attention on personnel policy, reduce the ability of the company to hire the most desirable men. A decrease in operational efficiency inevitably results. The causes listed apply with equal force in both large and small businesses.

Among the "true causes" of turnover, as shown by studies made in all types of businesses, are:

1. Poor selection
2. Poor induction
3. Poor training
4. Indefinite and poorly administered wage and salary programs
5. Poor supervision — supervisors who are not leaders
6. Unattractive plant and office
7. Lack of adequate communication with employees

REDUCE TURNOVER TO REDUCE TRAINING COSTS

AVERAGE TRAINING TIME AND COST

	Number of Companies	Average Training Time (In Weeks)	Number of Companies	Average Cost of Training (In Dollars)
SHOP AND MAINTENANCE				
Unskilled	26	2.36	26	$ 106.49
Semi-skilled	25	3.72	24	187.96
Skilled	24	6.75	23	381.20
TECHNICAL				
Routine	12	5.83	6	168.08
Design	11	11.00	6	731.82
OFFICE				
Routine	29	4.07	27	169.26
Specialized	25	7.36	18	342.35
SUPERVISION				
First Line	15	15.00	10	1213.68
Major	14	34.57	6	3397.23
STAFF AND ADMINISTRATION				
Minor	12	26.33	3	1548.40
Major	12	46.83	2	4980.00

—Merchants and Manufacturers Assn.

Many employers believe that such positive accomplishments of personal investigations are equally as important as the negative one of keeping bad apples out of the barrel. The selection of employees who have an even family life, good work and attendance records, and are skillful, cooperative, willing to learn, ambitious and company-minded, is certainly the simplest way to achieve higher over-all morale, productivity and consequently greater company profits.

An Example

Although many advantages of investigating are self-evident, a major eastern electronics firm—which we will call Kontrols Korp.—had an ideal opportunity to statistically evaluate the effectiveness of the service. This occurred a few years ago when the company moved to establish a semi-autonomous branch in the west.

The city was filled with post-war nomads from all over the United States, and it was from this group that virtually the entire work force of 1000 persons was to be chosen. Kontrols Korp. executives were

Investigation *(Concluded)*

particularly concerned with the high national absenteeism and turnover rate. Although they were cognizant of the fact that a certain turnover is necessary, they determined that this national rate could be reduced radically. Available research indicated that one in every six applicants for jobs had either falsified the extent of his experience as revealed by a poor work record, had unacceptable personal or personality problems, or other traits that made him non-employable for the position for which he applied.

During one of the full recruiting years in which investigations were used, some significant statistics were compiled: about 10,000 persons applied to Kontrols Korp. for employment. Of these 5000 were automatically turned away because of the obvious lack of proper experience indicated by their questionnaires. Personnel department interviewers rejected another 2500 for adverse character traits or various other reasons. Supervisors interviewed three (on the average) of those who qualified for each job and were directed to select the one they believed best fitted. These were then given standard employment tests. During the selection process about 50 applicants accepted jobs with other companies or withdrew their applications when they learned they would be investigated.

INVESTIGATE BEFORE YOU HIRE!

After probation you may be stuck paying these fringe benefits to an undesirable employee:* as well as to competent persons.

	Hourly Costs
Cost of living	16.9¢
Vacations	14.2¢
Bargaining unit pensions	13.8¢
Overtime premiums	13.7¢
Holidays	8.1¢
Social Security Payments	7.5¢
Shift differential	4.6¢
Supplementary unemployment benefits	4.5¢
Bargaining unit insurance	4.3¢
State and Federal unemployment insurance	3.6¢
Non-bargaining unit pensions	2.2¢
Workmen's compensation	1.4¢
Non-bargaining unit insurance	1.0¢
Individual income security	0.5¢
Suggestions	0.3¢
Jury duty	0.1¢

Based on a normal year of 2,000 hours worked, the total cost per employee runs to about 97 cents an hour.

Timken Roller Bearing Co., Canton, Ohio

The names and pertinent information concerning the remaining 800 applicants were submitted for varying degrees of investigation (depending upon age, work history, etc.) of former places of employment, job skills and training, absence record, neighborhood or community reputation, character, financial responsibility, moral standards, subversive activities or arrest records when available. As a result of facts obtained 300—or 37% of the 800 applicants who had been well-screened before personal PEI were rejected by the company!

Some Statistics

The worth of this program came two years later when the statistics revealed that absenteeism had been kept under 2% and monthly turnover at 1.5%.

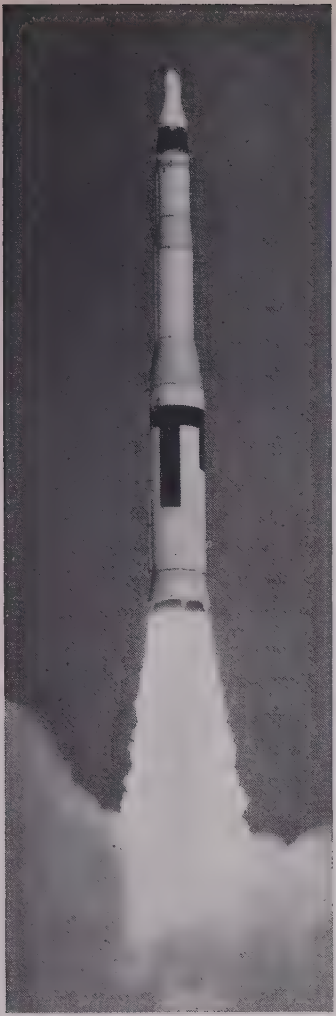
Now let's examine absenteeism—a sort of temporary turnover. According to a major study conducted at General Motors, there is a 2.5% reduction in production for every 1% absenteeism. Suppose we assume that in any large plant of 1000 employees, each statistical employee contributes equally to the over-all production. If you have 4% absenteeism and multiply this by General Motors' 2.5%, your production would be reduced 10%. This is the equivalent of another 100 people in your coffeeshop all day long.

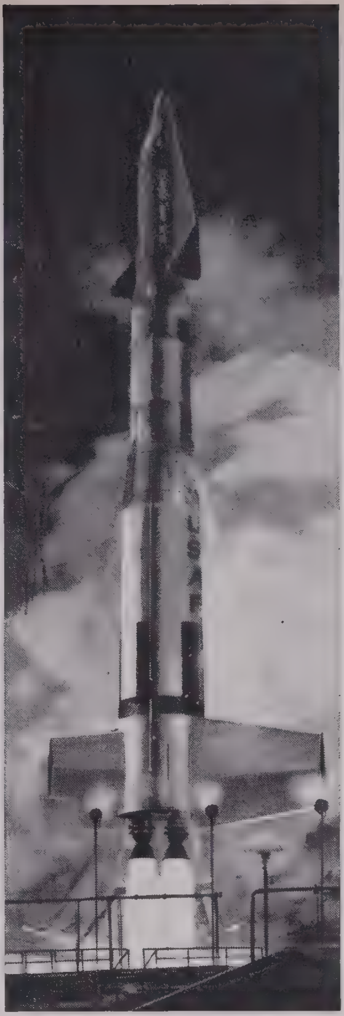
If you can cut turnover to 1% and absenteeism to 2% by sharp selection methods and good internal employee relations, how much would you save? Well, the selection part is the simplest and the cheapest; personal investigation coupled with modern augmentary selection procedures—which most 1000-employee plants already have—is a big part of the solution. The other part is the caliber of the supervisory force. And these people, if you promote from within, have many of the prerequisites.

What Does Turnover Cost?

A psychologist once remarked, "An employee gives three reasons he left his previous employment: the reason he gives his prospective employer; the reason he tells himself; and the real reason." If you can discover these real reasons and after you have assessed them and they indicate a prospective employee lied about his qualifications, the company has saved itself a total of $788.99, according to the results of a Merchants and Manufacturers Assn. study below:

Employment Cost: advertising, recruitment, testing, supplies, wages and salaries, physical examinations, overhead, etc.	$ 78.31
Break-in Cost: expense of sub-standard production of new employees while learning their job assignments and becoming adjusted to their work environment	305.84
Breaking-in Cost: the dollar value of time spent by supervisors and other employees who assist in breaking in new employees on their job assignments	120.44
Separation Cost: processing and exit interviews, supplies, etc.	7.86
Social Security Tax Costs: that extra tax contribution that must be borne by the employed because of labor turnover	17.44
Loss Production and Extra Burden Cost: such as brought about because of the resultant understaffing of company facilities due to labor turnover, i.e., length of time to secure replacement workers, overhead burden rate of the company and its application against reduced units of production and the additional overtime worked to maintain a normal production level	248.84
State Unemployment Insurance Tax Cost: cost of higher rate due to claims and loss of exemption from payment after accrued salary limits	10.26
Total	$788.99





Immediate Minuteman and Dyna-Soar openings for Electronic and Electrical Engineers

Electronics is one of the fastest growing areas of engineering at Boeing. Electronic and electrical engineers interested in the advancement of space-age technologies will find challenging and deeply rewarding opportunities in advanced Boeing programs, including the Dyna-Soar manned space glider and the solid-fuel Minuteman ICBM. Assignments exist in your particular area of interest and at the level you require for career satisfaction and advancement. For your convenience, a professional application form appears at the right, and continues on the following page.

MAIL FORM TODAY

RETURN TO: MR. W. B. EVANS
THE BOEING COMPANY
P. O. BOX 3707-EIB
SEATTLE 24, WASHINGTON

PROFESSIONAL POSITION APPLICATION
(All replies held in strict confidence)

Date of this Application________________

Name________________
LAST FIRST MIDDLE (USE NO INITIALS)

Social Security No.________________

Present Address________________
NO. STREET

____
CITY ZONE STATE

Telephone No.________________

Ht.________Wt.________Age________U.S. Citizen________

Male________Female________Marital Status________

No. of Children________Other Dependents________

U.S. Veteran________Entry Date________

Discharge Date________________

Type of Discharge________________

Spouse's Maiden Name________________

Employer________________

Previous Boeing Employee?________________

If the answer to following three questions is "yes," explain on supplementary sheet:

1) Have you any physical defects?________________

2) Have you ever been arrested (except traffic and juvenile)?

____

3) Have you ever received disability or accident compensation?________________

TURN PAGE ▶

HIGHER EDUCATION

College and Location	Dates Attended	Degree and Major
1.		
2.		

EMPLOYMENT HISTORY (Attach Resume)

Firm Name and Address	Base Pay 40 hr/Wk	Dates Employed Month/Year
1.		
Position & Duties		
2.		
Position & Duties		
3.		
Position & Duties		
4.		
Position & Duties		

REFERENCES. Give full names, occupations and addresses.
Professional (previous supervisor preferred):

1.__________

2.__________

Character (other than relatives or former employers):

1.__________

2.__________

LIST TYPE OF WORK PREFERRED UPON EMPLOYMENT:

Have you ever been cleared for classified military information?________. If yes, give date, level and company.

May we contact your former and present employer prior to completion of employment negotiations? Yes____ No____ If "yes," I authorize, without liability, the release of all employment and personal information.

SIGN YOUR NAME HERE

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

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Form begins on previous page

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BOEING

Industry News

Glenn E. Ronk—appointed Director of Marketing, Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., Newark, N. J.

Vincent A. Altomare — appointed Manager of Marketing and Sales, Computer Diode Corp., Lodi, N. J.

C. R. (Bob) Stone—appointed Director of Production, Potter & Brumfield Div., American Machine & Foundry Co., Princeton, Ind.

Robert J. Sullivan—appointed Manager of Liaison Engineering in Europe for Fairchild Controls Corp., subsidiary Fairchild Camera & Instrument Corp., Hicksville, L. I., N. Y.

R. J. Sullivan

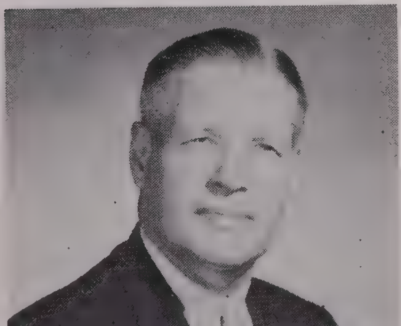
R. G. Kimbell, Jr.

Raymond G. Kimbell, Jr.—promoted to Midwestern Regional Sales Manager, Motorola Semiconductor Products Inc., Phoenix, Ariz.

Corning Glass Works, Corning, N. Y., announces the following appointments: **Dr. William H. Armistead**, Vice President, appointed Director of Technical Staffs; **Leroy A. Amylon**, Vice President, named Director of the Industrial Relations Div.

H. T. Harwood—appointed Director of Public Relations for Shure Bros., Inc., Evanston, Ill.

New Consulting Firm


Rodney D. Chipp has left his post as Director of Engineering, ITT Communication Systems, to set up Rodney D. Chipp Associates, Consulting Engineers. A Fellow of the IRE since 1955 and a pioneer in television and radar, Mr. Chipp was cited in WW II for "splendid design" of radar equipment. An MIT graduate, B.S. in Physics, he is a Professional Engineer in N.J. and N.Y.

FLIGHT SYSTEMS ENGINEER

The leading developer and manufacturer of air data systems* has an opening for a creative BSEE with five years of experience in the design and development of electronic or electromechanical equipment.

This outstanding position requires a recent background of high level design in servomechanisms and closed loop systems, plus a knowledge of small electromechanical components such as resolvers, gyros and synchros.

In addition to the above requirements, a thorough working familiarity in solid state devices and analog computer techniques would be very helpful.

U.S. citizenship or previous secret clearance required. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin. To arrange an interview, please send complete resume to Mr. Tom Watson.

**Garrett centralized air data systems are standard equipment on many of the Free World's supersonic aircraft, including the F-104 pictured above.*

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AiResearch Manufacturing Division
9851 So. Sepulveda Blvd., Los Angeles 45, California

Industry News

Donald C. McDonald—selected for the National Electronics Conf. 1961 Award of Merit.

William R. Weir — appointed National Sales Manager Semiconductor Div., Sylvania Electric Products Inc., Woburn, Mass.

James G. Walton — promoted to Manager, Rectifier Products Sales, General Electric Co.'s Rectifier Components Div., Auburn, N. Y.

Hughes Aircraft Co., Culver City, announces the appointments of **John D. Couturie**—named Assistant Treasurer and **William I. Green**—Group Controller.

Harold Miller — promoted to Vice President, Plant Operations, Hi-Q Div., Aerovox Corp., New Bedford, Mass.

Dean C. Smith—elected Vice President, Manufacturing, Oak Mfg. Co., Crystal Lake, Ill.

Harold H. Zander — appointed President of Amphenol-Borg Electronics GmbH, German affiliate of Amphenol-Borg Electronics Corp., Broadview, Ill.

Albert J. Harcher—named General Manager, Bendix Semiconductor Div., Bendix Corp., Holmdel, N. J.

Morton H. Cohen—named Manager, Washington Sales District Office, Electro-Mechanical Inc., Sarasota, Fla.

Maurice Friedman — elected Vice President, and Executive Assistant to the President, General Instrument Corp., Newark, N. J.

M. Friedman

A. N. Curtiss

Arthur N. Curtiss — promoted to Manager, Administration, RCA Laboratories, Princeton, N. J.

Eugene F. Peterson—elected Vice President, Marketing, Consumer and Industrial Products, International Telephone and Telegraph Corp., New York, N. Y.

Alite Div., U. S. Stoneware Co., announces the appointments of **Paul L. Schmitz** — Sales Manager, The Alite Div., and **Walter J. Tarnacki**—Manager, Alite High Alumnia Ceramic Manufacturing Operations.

William P. Sharpe, Jr.—appointed Marketing Manager, Plastic Products Div., International Resistance Co., Phila., Pa.

Frank Nascenzi—appointed Director of Administration, Manufacturing and Engineering Div., Burroughs Corp., Detroit, Mich.

Maurice Kates—elected President of Advanced Miniaturized Electronics, Inc., subsidiary Curtiss-Wright Corp., Wood-Ridge, N. J.

Semiconductor Specialists Inc., Chicago, Ill., adds to its field organization **Alan J. Mattal**, in the Michigan and Ohio area; and **Richard C. Swanson**, in the Minneapolis, St. Paul area.

Theodore R. Swenson — appointed Distributor Sales Manager, Eitel-McCullough, Inc., San Carlos, Calif.

Henry H. Hentrich — named Manager of Planning, Instruments for Industry, Inc., Hicksville, N. Y.

Fred Soufal—promoted to Midwest District Sales Manager, Motorola Semiconductor Products Inc., Phoenix, Ariz.

National | military electronics

Our rapidly expanding Military Development and Marketing Department in Dayton needs qualified, experienced men to fill these positions:

COMMUNICATION SYSTEM PROJECT MANAGER—8-12 years in development of complex high frequency communication systems. Several years experience as Project Manager in areas of digital and analog design, communication theory analysis, or systems organization. Ph.D. or MSEE.

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ELECTRONIC ENGINEERS — BSEE or MSEE, 2-5 years with electronic ground based and airborne equipment development. A background in one of the following areas is necessary: Circuit Design, Logic Design, Electronic Power Supplies, Electronic Packaging, or Test Equipment Design.

MECHANICAL ENGINEER — BSME or MSME, 2-5 years in design of mechanical assemblies. Should have a sound background in shock mounting and packaging of electronic equipment.

CIRCUIT ENGINEERS—BSEE or MSEE, 5-7 years in design of solid state and vacuum tube circuits. Experience in designing circuits for reliable operation under worst case conditions.

LOGIC ENGINEERS—BSEE or MSEE, 3-5 years in design of digital logic systems. Should be acquainted with methods of achieving reliable operation with minimum circuit elements.

COMMUNICATION SYSTEM ENGINEERS —BSEE or MSEE, 5-7 years in the high frequency communication area. Should have the experience in long distance propagation with emphasis on solution of multipath effects in the 2-30 mc range.

COMPONENT ENGINEERS — BSEE, 2-4 years in testing and evaluation of electronic components. Should be familiar with Mil Specs and component selection.

If you are qualified and interested in applying for one of these challenging positions, send your resume to: Mr. Thomas F. Wade, Technical Placement, The National Cash Register Company, Main and K Streets, Dayton 9, Ohio. All qualified applicants will be considered regardless of race, creed, color, or national origin.

Circle 803 on "Opportunities" Inquiry Card

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RADAR SYSTEMS ENGINEERS

To integrate varied data acquisition equipment into complex electronic control systems.

TELECOMMUNICATIONS ENGINEERS

To design and develop advanced communications subsystems of ground electronic control system complex.

SENIOR PROGRAMMERS

Will be responsible for the overall planning and supervision of computer programs. Will assign, outline and coordinate work of programmers and write and debug complex programs involving mathematical equations. Requires experience in the operation and programming of large electronic data processing systems, such as the AN/FSQ-7N8, IBM 700 series, or Philco S-2000 series.

COMPUTER PROGRAMMERS

To develop and/or analyze logic diagrams, translate detailed flow charts into coded machine instructions, test run programs and write descriptions of completed programs. Requires experience in the operation and programming of large electronic data processing systems, such as the AN/FSQ-7N8, IBM 700 series, or Philco S-2000 series.

TECHNICAL WRITERS

To write and publish technical reports on Communications, Radar, Fire Control Systems, Electrical and Mechanical Devices and Computers.

CABLE ENGINEERS

To resolve varied grounding and shielding problems of complex electronic equipments.

RADAR DESIGN ENGINEERS

To work on advanced designs—to develop receivers using parametric amplifiers.

SUB-SYSTEMS TEST ENGINEERS

To plan, prepare and generate specifications for sub-systems test, data reduction and analysis programs. Will be responsible for the preparation of test plans, installation of equipment, test instrumentation, collection of test data and analysis of results. Resolve incompatibility and interface engineering problems.

SYSTEMS TEST ENGINEERS

To plan, prepare and generate system test, data reduction, and analysis specifications. Develop methods and procedures for test implementation. Coordinate between interested agencies, and resolve problems between the specifications, test methods and actual procedures in use.

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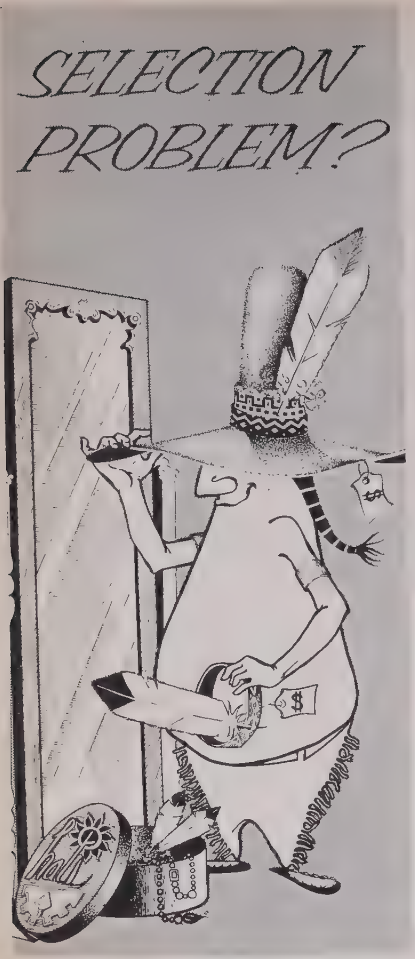

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Circle 165 on Inquiry Card

Industry News

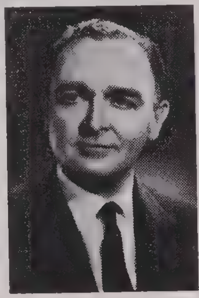
Robert L. McCelvey — appointed Sales Manager, Electrodynamic Instrument Corp., Houston, Tex.

Joseph P. Roveto, Jr.—promoted to Manager, Industrial OEM Sales, Industrial Components Div., Raytheon Co., Newton, Mass.

Robert F. Meadows—named Marketing Manager, Contract Products Div., Wright Machinery Co., Div. of Sperry Rand Corp., Durham, N. C.

Thomas H. Armstrong—appointed Manager of Government Relations, Univac Div., Sperry Rand Corp., New York, N. Y.

T. H. Armstrong


R. J. Bailey

R. J. (Bill) Bailey—appointed Vice President, Marconi Instruments Div., English Electric Corp., Englewood, N. J.

Edward A. Hebditch — appointed Executive Assistant to the President, Gulton Industries, Inc., Metuchen, N. J.

George J. Muller — promoted to Manager, Special Projects Group, Taylor Fibre Co., Norristown, Pa.

Raymond R. Kondrat — appointed Manager, Industrial Products, Nuclear Products Group, Metals & Controls Inc., Div. Texas Instruments Incorporated, Attleboro, Mass.

Robert B. Wyland — elected Vice President of Human Relations, Daystrom, Inc., Murray Hill, N. J.

Fred M. Heddinger—to Head the Semiconductor Molecular Electronics Dept., Westinghouse Electric Corp., Youngwood, Pa.

Joseph F. O'Marah—named Special Assistant to the President, Frederick Research Corp., Wheaton, Md.

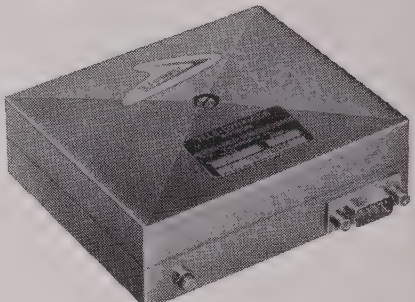
Robert Provart—appointed Director, Astromatic Div., Controls Co. of America, El Segundo, Calif.

Transitron Electronic Corp., Wakefield, Mass., announces the appointments of **Windsor H. Hunter**—Director of Development and **Roderick E. Hall**—Director of Special Products.

TELEMETRY BY TELE-DYNAMICS

1 and 2 -watt

Transistorized FM Transmitters



If you've a need for light—17 ounces—extremely compact—20 cu. in.—215 to 260 telemetry transmitters, specify Tele-Dynamic's Type 1053A and Type 1055A.

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These units, representative of Tele-Dynamic's latest creative effort in the complete telemetry field, are capable of being combined into various custom systems and are low in cost.

For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone TRinity 8-3000. 8412

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DIVISION
AMERICAN BOSCH ARMA
CORPORATION
5000 Parkside Ave., Philadelphia 31, Pa.
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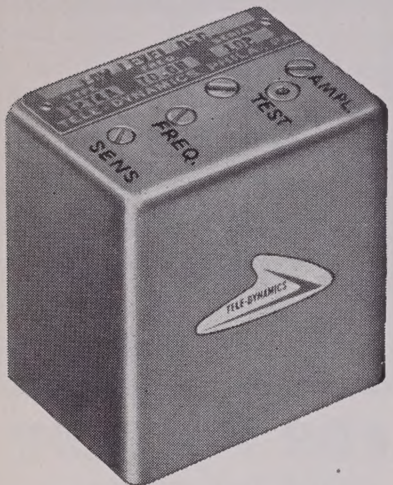
TELEMETRY BY TELE-DYNAMICS

NEW Low Level Subcarrier Oscillator



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For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone: TRinity 8-3000.

8410

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DIVISION
AMERICAN BOSCH ARMA CORPORATION
5000 Parkside Ave., Philadelphia 31, Pa.

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EQUIPMENT, MATERIALS, PARTS & COMPONENTS

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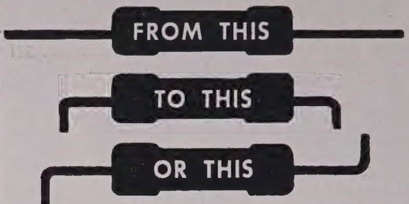

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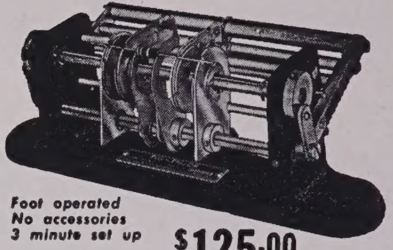

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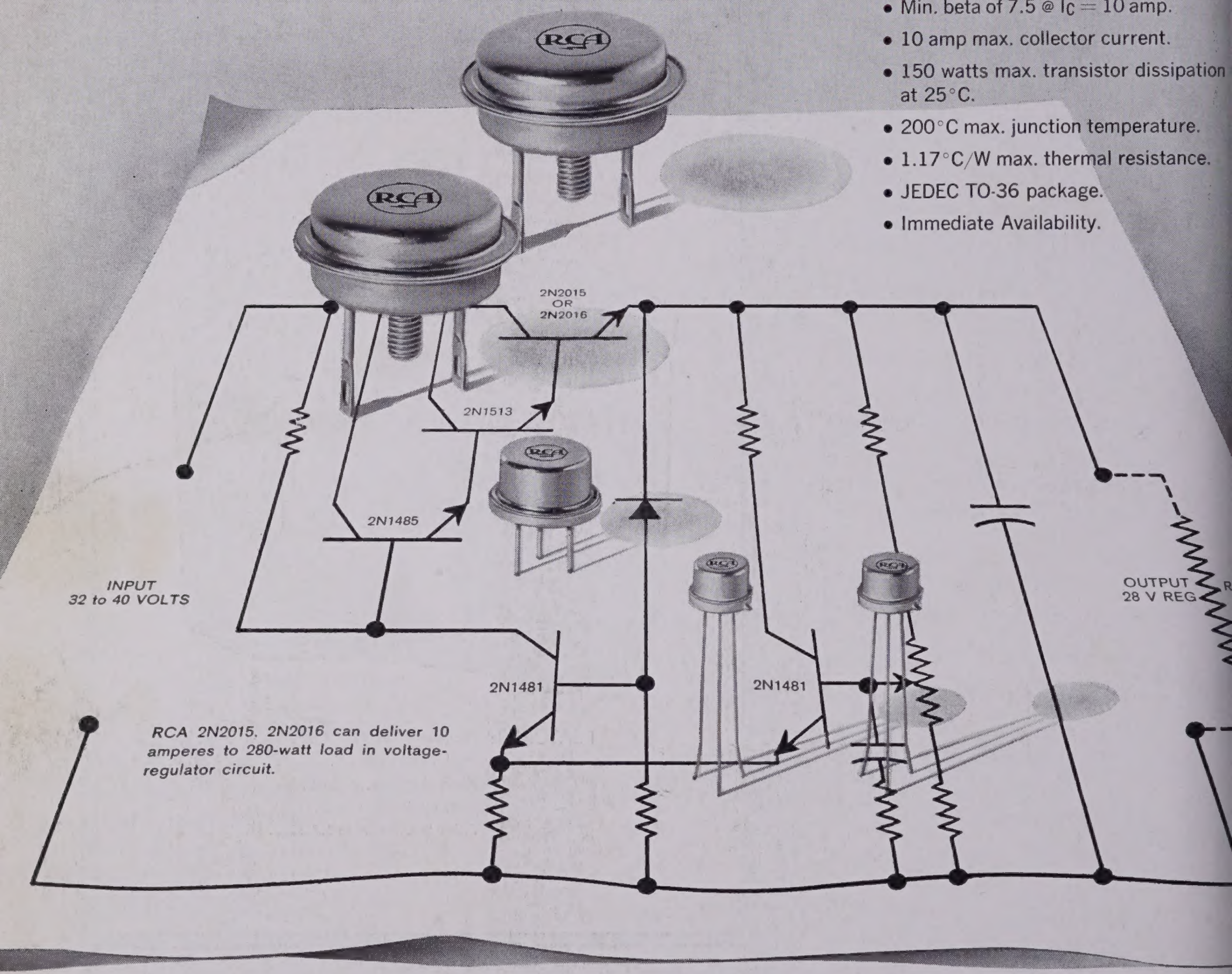

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